AMERICAN DYESTUFF REPORTER

"Circulated Everywhere Dyestuffs Are Used"

Published by Howes Publishing Company, 90 William Street, New York

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

Volume XVIII NEW YORK, SEPTEMBER 16, 1929 Number 16

The Removal of Stains From Building Stones

An Unique Adventure in Applied Chemistry in Which Patient Experiment Outwitted Vandals

By WALTER E. HADLEY

EARLY in the spring of 1923 construction work was well under way on the new high school which the town of M———, N. J., had decided to build. Already the foundation was laid and certain sections showed one, and in some cases two stories, fairly complete.

The plans and specifications for the building called for Indiana Limestone, the ready cut stone, varying in size from blocks two and three feet long, to pillars fifteen feet long and four feet in diameter, weighing several tons. The value of this ready-cut stone stored in the yard was estimated to be worth at least $30,000.

It is true that those troubles which are always bound to occur where large contracts are being carried out had at times cropped up, but to all intents and purposes no greater difficulties had been encountered on this particular work than had been met in many similar instances. Therefore one can readily imagine their astonishment when the workmen assembled one morning to find that during the night vandals had spilled ink over the ready-cut stones as they lay spread out in piles in the yard, ready to be used in the construction of the building.

The first intimation that I had that such an act of vandalism had been perpetrated was an item which appeared in one of the Newark evening papers giving in detail an outline of the destruction of the stone, which apparently had been carried out some time during the previous night. The following day one of the directors of the company in charge of the construction work requested me to go with him and view the damage which had been done. On the way to the site of the new building he stated that if the stains could not be removed new stock would have to be obtained from the quarries and cut to proper size and shape. What apparently did not occur to him was the likelihood that if the stains could not be removed from the stock already prepared it would be a comparatively simple matter to deface, by the same means, any new stock as received, which would have postponed, if not prevented, the completion of the building.

When we arrived at the building I was nonplused to see the thoroughness with which the attempted destruction had been carried out. Already eleven empty quart ink bottles, which had contained a popular brand of so-called indelible ink, had been found scattered about the yard, bearing mute evidence to the careful planning of those who sought by this means to prevent the erection of the building. Where the rocks had been piled eight and ten high, one upon the other, sufficient ink had been spilled on the top stone so that it had run over the edges, thus finding its way on to the under stones. Thus a comparatively small amount of stain had injured many stones. The result was that all the stones in the pile were damaged to a greater or less extent, and a cursory examination certainly indicated that the damage was to a greater, rather than to a lesser, degree.

Throughout the premises where the cut stones were piled could be seen groups of men and boys walking at will over the stones, which I felt sure would have been carefully guarded against such treatment had not the feeling already become existent that the stones would never be successfully cleaned, and consequently no further harm could be done to them. I suggested that if the stones were to be eventually salvaged and still be satisfactory for use, steps should be taken to see that no further damage was incurred. Orders were immediately given that curiosity seekers and all others were to be kept off the stones, and guards were placed to accomplish this purpose.

There was no dearth of suggestions from those who sought to remove the stains and apparently every suggestion was being welcomed. Already at least half a dozen different people, some working as individuals and others in groups, were busily engaged in trying what prob-

ably seemed to them logical means for clearing the stains from the stones. Two men introduced to me as chemists had taken over a small building on the property and had obtained one of the badly stained, but otherwise perfect, stones and were industriously working in an endeavor to remove the discoloration. Their method seemed to be centered upon the idea of forcing a solution of what appeared to be hydrogen peroxide into the interior of the stone. The method used, as far as I could observe, consisted in a vigorous rubbing of the stain with a glass rod. This rubbing had been persisted in long enough so that a portion of the stain had been completely removed, but unfortunately for the purpose in hand, the stone had also been removed to a depth of about one-eighth of an inch at the treated portions. The blue stain of the ink still remaining on the surface, and that buried deep within the structure of the stone was still as bright as ever. With a feeling that it would be a long time before the stones could be cleared by such a treatment, the two chemists were left in their secret room to continue the rubbing treatment to their full satisfaction. Incidentally, the stone upon which they were working was the only one which did not eventually find its way into the building.

Outside in the yard, scattered here and there, other experimenters were endeavoring, each in their own way, to solve the problem.

One man had suggested that the stones be treated with live steam, for what reason I know not, but nevertheless a long section of steam pipe had been laid from a portable boiler, and there he was blowing live steam onto one of the large pillars to his heart's content. The stain was still as bright as at first, if not more brilliant.

Still another man was working on the theory that lime, slaked in contact with the stain, would successfully remove the color, and if the amount of slaked lime he used was any criterion of the good he hoped to accomplish, he at least should have met with a considerable measure of success. The stain, however, still persisted under his treatment.

At this stage of the investigation, inquiry was made as to whether the stones upon which the different ones were experimenting were of any value and it was found that, with the exception of the one receiving the hydrogen peroxide treatment, all contained imperfections which would have prohibited their use in the building, and I received assurance that no perfect stones would be tampered with until my investigation was complete.

An official of the company had gone to Boston immediately upon discovery of the stains, taking with him one of the empty quart bottles, in order to interview the manufacturers of the ink in an endeavor to learn whether they could offer any suggestions for removing the stains. As to whether the ink manufacturers felt that an indelible marking ink should really be indelible, and remain permanent, I do not know, but I do know that they had no practical suggestions to offer as to its removal from stone. Thus, when I was requested to view the condition of the cut stone and to suggest a possible means of remedying the situation, it would seem that practically everything had been done which seemed to offer any plausible method of cleaning up the damage.

The vandals had not been particularly sparing with the ink; in many places even the ground was badly stained where an excessive amount had been poured on the rocks. The spots on the rocks showed varying amounts of the stain, in some places so thick that a bronzed effect was apparent. The initial examination showed that the so-called indelible ink was soluble in water, and even more easily soluble in alcohol. Fortunately the weather had been dry, no rain having fallen since the damage had been done, and consequently the ink had not spread beyond the sections over which it had first been poured.

Preliminary Treatment to Prevent Spreading of Stains

The excess of ink was first carefully washed from off the stones by rubbing with cheese cloth saturated with luke-warm water. All the stones in the yard were gone over by this process, which did not consume a great deal of time, and prevented the stones from absorbing any more of the extraneous color. The excess of color was thus easily removed, but the general appearance of the stone was not improved in any way. What at first had been a highly concentrated localized color had become slightly lessened in intensity, but no headway had been made in the removal of that portion of color which had penetrated beneath the surface of the rock. We felt, however, that distinct progress had been made, inasmuch as no further staining would be possible from the excess ink.

When continued treatment with water no longer removed any color, cheese-cloth saturated with alcohol was carefully rubbed over the stains. While the color on the stones in many instances still showed very strongly, we knew that thus far we were proceeding along correct lines, for the cheese-cloth was constantly taking up color, and as long as this condition could be maintained subsurface color was being removed. Finally the time came when even the alcohol ceased to remove appreciable quantities of color. The spots, when allowed to dry, were found to be greatly reduced in color, but we realized that nothing short of complete removal would be satisfactory either to the contractors themselves or to the school authorities.

The stain, instead of being a deep bronzy, violet color as at first, now showed beneath the surface of the rock as a dull bluish gray discoloration.

Work Concentrated on a Single Stone

The foregoing procedure refers to the treatment which was given to all the damaged stock, as rapidly as possible.

in order to arrest further primary damage. With this preliminary protective work completed, attention was concentrated on a single stone, which I was gratified to observe was in perfect condition, with the exception, of course, that it was deeply stained.

Experiments had already been made to observe the action of chlorine on the ink, and it had been quickly found that the cheese-cloth used for removing the excess color was readily whitened by the action of chlorine water. The only remaining problem, therefore, apparently had narrowed to one of ability to penetrate beneath the surface of the stone and destroy the color, at least to such a depth as would not show any shading on the surface of the finished rock.

The stone, placed in such a position that the stained portion was on the top, was covered with several layers of cheese-cloth, which was then saturated with a clear solution prepared from bleaching powder (calcium hypochlorite) possessing a strength of approximately 8° Tw., thus giving a relatively high chlorine concentration. The cloth was kept wet with the bleach solution for several hours during the late afternoon, and finally was allowed to remain on the stone overnight. That evening I left the work very much encouraged, as it could be seen that very definite progress was apparently being made. We were optimistic enough to believe that the morning would show the trial stone satisfactorily cleaned.

Optimism Not Justified

As it proved, however, our hopes and expectations were not to be so easily realized. When one of the contractors called for me the next morning, I knew as soon as I saw the expression on his face that all was not well. The treatment which had been apparently progressing so favorably the night before had completely stopped, and while the workman was still faithfully proceeding with the treatment according to instructions, no further clearing of the stain was evident.

During the half-hour ride to the site of the new building I did very little talking, but considerable thinking, the result being that by the time we arrived, I had evolved two theories:

(1) That while the color was readily bleached when by itself, or on the cloth, or even on the outer surface of the stone, it might be that the porosity of the stone was not great enough to permit penetration of the solutions being used.

(2) That some unforeseen condition had arisen that was sealing the pores of the rock and preventing the penetration of the chemicals.

Inasmuch as the bleaching treatment had started off so propitiously and the color had proved so sensitive to chlorine, I felt certain that something must have happened that was preventing the chlorine from reaching the color.

It must be borne in mind that we were constantly confronted with the absolute necessity of preserving the rock surface, and at the same time restoring the same to its original color.

Not caring to admit as possible Theory 1, I concentrated on Theory 2. Having used such a strong solution of calcium hypochlorite, it seemed as though there must be a very definite possibility of the carbon dioxide of the air having produced calcium carbonate upon, and just beneath, the surface of the stone, thus preventing penetration of the chlorine solution. If this condition was a fact then the film of calcium carbonate would have to be removed before further penetration could take place.

Owing to the nature of Indiana Limestone no acids could be used to assist in breaking up the calcium carbonate. A pail of warm water was obtained, together with a coarse stiff-bristle brush, and the stone was given a thorough wash, being scrubbed in the direction of the parallel corrugated lines which characterized the peculiar finish of the stone. When the washing was complete no change could be noticed in the general appearance of the stone, neither was any color in evidence in the wash water. When the rock was allowed to dry, a dull gray sub-surface discoloration was still apparent, though greatly reduced both in volume and intensity, and would not now have suggested having been caused by artificial coloring matter.

The use of alcohol was again resorted to, and this time no action of any kind was discernible. Still feeling that the calcium carbonate would have been more or less broken up by the thorough scrubbing, and realizing that the stain must, of necessity, be deeply seated, we continued the application of the alcohol. After about one-half hour faint streaks of blue color began to appear on the surface, indicating that the film of calcium carbonate had been broken, and that once more color was being drawn to the surface of the stone and removed. The alcohol treatment was continued until only very faint traces of color were being extracted. Finally, a fresh application of bleaching solution was made, and the stone thoroughly washed and dried. The stain had now apparently completely disappeared.

Final Examination of Cleaned Stone

Three disinterested men were asked to express an opinion as to the general appearance of the stone, and to designate that portion, which in their opinion, had been originally stained. Each one chose a different portion, but none chose the spot where the stain had been.

The complete removal of the stain from the trial stone was the basis for proceeding with the treatment of the entire lot, and from that time on we had the satisfaction of seeing stones, coming wet from under the treatment, being put immediately in place in the building.

Chemicals Used

Approximately ten gallons of denatured alcohol and fifty gallons of strong calcium hypochlorite solution and two bolts of cheese-cloth had been required to clean the entire lot, and the work had been performed by one laborer who had closely followed directions.

Vandal Again Appears

Several weeks after the salvaging of the stones had been completed and construction was again moving smoothly along, it seems that the close guard maintained for some time was relaxed. During one of the noon hours, when most of the workmen were away at lunch, a stranger was seen moving around on one of the scaffolds near some of the large pillars at the entrance of the building. When spoken to he leaped to the ground and started away as rapidly as he could travel. Help was summoned, and he was followed; the police were immediately notified, and a "motor cop" was soon on the trail, but in his enthusiastic endeavors he turned a corner too rapidly and was badly cut up and his cycle damaged. In the confusion and excitement the man managed to escape.

Upon returning to the building it was found that the man's visit had been made with the object of still further damaging the stone, and, strange as it may seem, the same character of ink had again been poured upon the stone. The trouble was quickly overcome by the treatment previously used for cleaning.

Thereafter, the construction of the building proceeded without further incident to a successful conclusion.

Several years have elapsed since the stains were removed, and time has shown not the slightest tendency to change those portions of the stones which received the treatment, or to bring any stains into evidence.

The Bleaching of Silk

Bleaching by Means of Aqua Regia—Bleaching with Sulphurous Acid—Use of Sodium Hydrosulphite—Bleaching with Peroxides—Potassium Permanganates and the Perborates—Tussah Silk—Aftertreatment—Bleaching of Half-Silk Fabrics

By THOMAS F. HUGHES
Providence, R. I.

THE silk fiber, being very similar in its chemical properties to wool, is bleached in much the same manner, that is, by the use of sulphurous acid or with sodium peroxide. In the case of yellow gum silk where it is desirable to preserve a considerable amount of the gum, the bleaching is frequently preceded by a treatment with nitric acid, which has for its purpose the destruction of the yellow coloring matter in the gum.

Yellow gum silk is bleached with aqua regia of 30° Bé. concentration before soupling, and is then sulphured. White gum silk requires sulphuring only, or the yellow tone may be corrected by tinting with Methyl Violet. Yellow gum silk will bleach up as white as the other silks, for it must be borne in mind that the yellow color in such silk is in the gum and not in the fiber itself. A great deal of the best Italian silk has a yellow gum. When this is removed by proper boiling off, the silk fiber proper is left in a fine white condition, but when all of the gum is not removed as in the case of "ecru" or "soupled" silk, it may become necessary to bleach out the yellow color from the gum as described above.

Bleaching Silk by Means of Aqua Regia

This method is seldom employed for the bleaching of boiled-off white silk, but only as a preliminary treatment to the bleaching of yellow gum silk where the after bleaching is to take place with the use of sulphurous acid. The method is carried out in the following manner: The yellow silk is first softened and cleaned by working for about one hour in a warm bath consisting of a 10% soap solution, and it is then washed to remove all trace of soap and is immersed in a bath of aqua regia standing at 40° Tw. The aqua regia is made by mixing 5 parts of commercial hydrochloric acid with 1 part of nitric acid, and allowing it to stand for four days at 75° F. The silk is now steeped in this acid bath until it turns green, after which it is taken out well washed, treated with sulphurous acid and soupled.

When bleaching silk with aqua regia or with nitrosyl-sulphuric acid the bath must be made up in a stoneware tank on account of the corrosive nature of the acid. Care must be taken not to steep the silk in the acid liquor for too long a time, as it may acquire a permanent yellow cast or tint from the action of the nitric acid on the fiber. Instead of using aqua regia a nitrosyl-sulphuric acid may be employed prepared from the chamber crystals forming in the lead chambers in the manufacture of sulphuric acid. The acid bath is used at a strength of 40° Tw., and the silk is immersed in it for fifteen minutes, and if the acid treatment is too long the silk will acquire a yellow tint which cannot subsequently be removed.

After steeping in this acid bath the silk is well washed and sulphured and soupled as before. The nitrosyl-

sulphuric acid solution may also be prepared by using a 10% solution of sodium nitrite strongly acidified with sulphuric acid. Silk may also be bleached with a bath containing 5% of sulphuric acid and 1% of sodium nitrate, and the silk must be thoroughly rinsed immediately after leaving the bath or it will become spotty.

Bleaching with Sulphurous Acid

The principle of this method is the reduction of the coloring matter with the sulphurous acid, which may be employed in either the form of sulphur dioxide gas or as a solution of sulphur dioxide or sodium bisulphite in water. The method of treatment is very simple: the silk, after boiling off or soupling, is hung up in a suitable chamber where it may be exposed for from four to six hours to the actions of the fumes of burning sulphur in case of the gas bleach, or steeped in a solution of sodium bisulphite in case of the liquid bleach. About one-half pound of sulphur is required to be burned per 1,000 cubic feet of space in the bleaching chamber when the gas method is employed, and this will usually result in the use of 5 pounds of sulphur for 100 pounds of silk.

As with wool, the sulphurous acid bleach on silk is not permanent, for the yellow color returns after some time. This is probably due to the reoxidation of the reduced coloring matter with the result that the original pigment is formed again. The sulphur bleach on silk is also destroyed to a greater or less extent by an aftertreatment with soap or alkaline baths so that this method of bleaching is of little use for silk which is to be dyed subsequently in light colors where a soap is used. On account of its cheapness, however, the sulphur bleach is still largely employed for silk.

The use of sulphur dioxide gas, in the case of silk, is much more efficient as a bleaching agent than solutions of sulphurous acid or sodium bisulphite, on which account the latter is very seldom used in connection with silk.

Use of Sodium Hydrosulphite

Sodium hydrosulphite may be used for the bleaching of silk. The soupled silk is steeped in the solution for six hours and then well wrung out and immediately washed, and if the washing is delayed too long the silk will heat up and become injured in luster and strength. After washing the silk should be run through a bath of dilute hydrochloric acid in order to remove all traces of zinc compounds, otherwise stains are liable to develop. After the acid bath the silk is finally well washed in two or three waters.

Hydrogen peroxide has been used for a number of years in the bleaching of silk, but in many cases the cheaper sodium peroxide is used. The principle of the bleaching action depends on the oxidation of the coloring matter by means of the solution of hydrogen peroxide employed.

Whether hydrogen peroxide itself is originally employed or solutions of sodium peroxide makes no difference in the essential action from a chemical point of view, for the solution of sodium peroxide also gives hydrogen peroxide; the same agent acts in either case and it is well for bleachers to remember this. The bleach obtained in this manner is one of oxidation and leads to the ultimate destruction of the coloring matter so that this bleach is a permanent one, therefore much better in the end than the sulphur bleach.

Solutions of hydrogen peroxide may be employed either cold or hot for the bleaching of silk, but the hot bath is preferable. In the former case the bath is prepared by diluting a quantity of 12-volume solution of hydrogen peroxide with three times its volume of cold water and adding sufficient ammonia to cause the liquid to smell of it very distinctly.

The bleaching bath is prepared as follows: For 100 pounds of silk use a bath containing 130 gallons of water, 25 gallons hydrogen peroxide, 12 pounds of sodium silicate and 12 pounds of soap dissolved in water, and now immerse the silk completely and have the bath at 130° F. After the silk is bleached sour with weak sulphuric acid and then wash thoroughly and see that there is no free acid left in the goods. Instead of ammonia, borax, magnesia and silicate of soda may be used as the alkali.

It is well to remove the silk from the bath as soon as the desired white is obtained, as leaving the goods too long will impair the strength and luster.

When employed hot the hydrogen peroxide bath is made up with 1 part of 12-volume hydrogen peroxide and from 10 to 20 parts of water, according to the degree of bleach desired. Either ammonia or the other alkalies mentioned above are added, and the silk is entered and worked for fifteen minutes, after which the bath is gradually heated up to 190° F. during one hour and then maintained at that temperature for forty-five minutes, after which the silk is washed off.

Owing to the expense of hydrogen peroxide, it is frequently replaced by sodium peroxide as stated above. The sodium peroxide bath for silk is prepared as follows: The author has used this bath for many years in the bleaching of silk and has found it perfect. For 100 pounds of silk use a bath containing 160 gallons of water; stir in 10 pounds of concentrated sulphuric acid and then with a large spoon, and very cautiously, add 7½ pounds of sodium peroxide; then add 5 pounds of sodium silicate and finally 5 pounds of soap in solution and use this bath at 180° F. Great care must be taken in the preparation of the sodium peroxide bath, and all chemicals and vats used should be free from traces of iron, otherwise the bleach obtained will not be satisfactory.

Potassium Permanganate

Silk may be bleached with this regent as follows: The silk is first soaked for fifteen minutes in a cold bath containing 1 pound of potassium permanganate to 10

gallons of water. It is then squeezed out and entered in a bath containing sulphurous acid or sodium bisulphite and sulphuric acid, until the brown color which it first acquires is changed to a white.

Care should be taken that the action of the chemicals should not be too prolonged, and the baths should be cold and not over 60° F.

Bleaching with Perborates

Like sodium peroxide the perborates (sodium or magnesium) are capable of forming hydrogen peroxide in solution under proper treatment, and on this account have been put forward as an available bleaching agent for silk. Sodium perborate is prepared from sodium peroxide and boric acid, and as compounds derived from borax are all rather expensive when compared commercially with sodium compounds alone, it is reasonable to expect that sodium perborate would be more costly than sodium peroxide when based on an equivalence of available oxygen. Commercial sodium perborate contains only 10.4% of active oxygen, whereas sodium peroxide contains about 20%, or practically twice as much.

In its general application to bleaching purposes, sodium perborate is very similar to sodium peroxide or hydrogen peroxide. In fact, the various per-oxygen chemical compounds which have from time to time been suggested as capable bleaching agents such as perborates and persulphates all depend in the last analysis for their bleaching activity in the fact that they readily furnish a solution of hydrogen peroxide when dissolved in water or when their solutions are treated with a suitable acid.

It may be readily seen from the above that the bleaching process with all these regents comes down to a question of bleaching with hydrogen peroxide. In the consideration of this question the chief factors to be reckoned with are the comparative amounts of hydrogen peroxide formed from equal quantities of the different compounds and the relative cost of hydrogen peroxide thus produced, and whether the decomposition of the product brings into the solution other ingredients which may hinder the activity of the hydrogen peroxide in its bleaching efficiency. Sodium perborate is much more stable in its nature than sodium peroxide, and it was principally on this account that it attracted attention for purposes of bleaching.

While sodium peroxide would decompose with violent rapidity when dissolved in cold water, sodium perborate requires to be dissolved in hot water in order that it may be decomposed completely, and the resulting products are hydrogen peroxide and borax. It may be probable, however, that some or all of the borax exists in the solution as metaborate of sodium. It has not been demonstrated that bleaching baths prepared from sodium perborate are as efficient as the bath containing pure hydrogen peroxide alone, and solutions prepared from sodium perborate show a relatively higher cost for the same amount of active bleaching agent. In this respect sodium perborate is expensive out of all proportion when compared with sodium peroxide.

The liberation of hydrogen peroxide in perborate solutions may also be brought about by the addition of an acid, in which case an organic acid, and preferably formic acid, should be used. There are a number of perborates possible ranging in active oxygen content from about 4% to 16%, and the best commercial samples of sodium perborate show about 10% of active oxygen. Yarn or fabrics may be padded with a cold solution of sodium perborate and then steamed and washed, and the process repeated until a sufficient degree of bleaching is secured.

Perborates are usually recognized by producing an intense blood-red color with titanic acid in the presence of sulphuric acid, and solutions of sodium bichromate are turned blue on the addition of perborates. This test can be used to indicate when the exhaustion of the perborate bath is completed. Percarbonate of soda is used for the purpose of bleaching expensive silk materials, and is prepared electrolytically by passing a current of electricity through a concentrated solution of sodium carbonate at a low temperature; the solution of the electrolyte must be rather concentrated in order to allow the less soluble percarbonates to separate out. By dissolving sodium percarbonate in hot water, there is formed a solution of hydrogen peroxide and sodium carbonate, and in the bleaching of silk with this material it is advisable to use an acid bath to dissolve the sodium percarbonate in cold water and then to acidify with formic acid.

Bleaching Tussah Silk

Tussah silk is more difficult to bleach than mulberry silk on account of the greater amount of impurities in the fiber, and also by reason of the fact that the fiber is less amenable to the action of chemical reagents. Tussah silk is much more difficult to strip than mulberry silk, that is, the sericin is hard to remove, and as the stripping must precede the bleaching of silk it can readily be understood that the bleaching of tussah silk is not an easy problem. The author has found that the best method for bleaching tussah silk is in the use of sodium peroxide, since the sulphuring method does not seem to him to give satisfactory results. After degumming tussah silk the fiber still possesses a rather dark-brown color, and in this respect differs from mulberry silk, as the coloring matter is not present in the layer of gum, but also permeates the entire fiber. On this account the bleaching of tussah silk is by no means easy; it requires vigorous action to destroy the brown pigment matter. At the present time the peroxide method is chiefly used, the strength of the bath, the temperature, and the duration of treatment depending on the quality and natural color of the silks and on the degree of whiteness desired in the bleach.

For the bleaching of tussah silk the following process is recommended:

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Proceedings of the American Association of Textile Chemists and Colorists

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MEETING OF THE SOUTH-CENTRAL SECTION

THE midsummer meeting of the South-Central Section was held at the Fairyland Club, Lookout Mountain, Chattanooga, Tenn., on Saturday evening, August 17.

The thirty members present enjoyed the very comprehensive paper presented by William H. Mitchell, of the Permutit Company, on "Water and Its Relation to the Textile Industry." This paper is published below.

Water and Its Relation to the Textile Industry

By WILLIAM H. MITCHELL
Sales Engineer, Permutit Company

IT is a well-known fact that water in the textile mill has a great variety of industrial uses, such as scouring with soap and detergents, dyeing, bleaching, mercerizing and feeding steam boilers. That the character of the water supply is of great importance to the industry has been recognized for many decades. In fact, this consideration has been one of the principal ones in controlling the geographic distribution of the industry, and we therefore find our great textile centers in this country generally located in the Eastern and Southern States, where the water supplies are abundant and comparatively good.

During more recent years it has been found that great economies and improvements in quality can be effected by further purifications of these water supplies which were previously thought satisfactory in their natural state. This change of attitude has been largely brought about by the great improvements in the methods and equipment used in water purification. The net result of the improvements has been a decrease in the installation and operation costs of water purification plants and a great increase in the operating simplicity of the plants and the quality of water produced.

This progress in the field of water purification is not only resulting in the improvement of water supplies and textile products in the established textile centers, but it is also making the textile industry independent of location so far as geographic distribution has been influenced by the quality of the water supplies available.

In choosing a mill site it was formerly necessary to consider whether a complicated water-treating plant would be required, particularly if the water supply available was hard and required softening. Frequently locations that were otherwise attractive were abandoned because of hard water, experience having proven that even

with careful supervision the results from the water-treating process then in existence were only mediocre.

These conditions have changed. It is now an established fact that almost any natural water can, by simple treatment, be rendered equal to the best of supplies for the wet-processing of textiles. It is only necessary to consider the cost of treatment and the fixed charges on the investment for the proper water-treating system and to balance these items against the advantages of location, such as the availability of labor, cost of power, proximity of raw materials and of the market for the finished product, etc. There is no doubt that if the water-supply problem is considered in this light as a cost of manufacture it will open the eyes of manufacturers to other advantages that far outweigh the slightly higher cost of producing perfect water in many localities hereto considered unfavorable because of the character of the water supply.

The natural question which suggests itself after these general statements is: What are these developments that have simplified water purification, reduced cost of installation and operation, and produced such vast improvement in the results of treatment?

It is my purpose in the short period at my disposal to sketch briefly the principles involved in the various methods of water purification and to indicate how the art has advanced to the present state. To make this clear without spending too much time on fundamentals with which you are probably familiar, diagrammatic charts will be used.

Nature's Water Cycle

You are undoubtedly familiar with the cycle which exists in nature, the sun beating down on the surface of the earth evaporates the water and forms the clouds, and later these precipitate to form rain. The rain falling to the surface of the earth forms the natural sources of supply which are available for use: the surface waters in the forms of lakes and rivers and streams, and the ground waters in the forms of wells and mine waters.

We know that the water as it passes through the atmosphere on its way to the earth gathers certain impurities, principally these gaseous impurities shown here—oxygen, nitrogen, carbon dioxide and hydrogen sulphide. With these impurities in solution, the water which percolates through the crust of the earth is able to dissolve out certain other impurities from the rocks with which it comes in contact, and which we have classified here under the dissolved solids.

The other water which lies on the surface of the earth in the form of streams and lakes, of course, readily picks up impurities which can be carried into the water by mechanical means. The erosion by the stream passing through its bed brings sand and clay, iron and alumina salts into the water, and from the various industries lining the streams waste materials are collected.

Of course, the suspended matter can always be detected by simple comparisons with standards. The organic matter in suspension or solution is usually determined by the permanganate consumption of the water.

The amount of carbon dioxide is readily determined by the amount of alkali which the water consumes in the presence of phenolphthalein, and the hydrogen sulphide can be detected by its odor and quantitatively by lead acetate.

The next group is the dissolved solids. The salts calcium and magnesium which constitute the hardness can be determined by the amount of soap they consume. We all know that the calcium and magnesium salts react with soap to form insoluble compounds, and are therefore determined by the soap-consuming power of the water.

The organic and inorganic iron, which we have classified here, are the two forms in which we usually find iron present. In a surface supply the iron is most frequently present as complicated organic compounds, tannates and the like. These are the compounds that impart the high color to surface supplies. Some of these very highly colored surfaces are frequently referred to as cold tea because they become so brown.

The inorganic iron, on the other hand, usually occurs in well waters, and this iron is present in the form of the ferrous bicarbonate. The characteristics of these well waters are that when the sample of the water is drawn it is usually clear, but when it is permitted to stand for any length of time in the open air and the CO_2 holding the iron in solution escapes, it permits the iron to precipitate as the hydrated oxide. That is why you can usually recognize one of these chalybeate well waters by taking a sample of the water and allowing it to stand in a vessel in the open; you will find, if iron is present, it will precipitate within anywhere from a half hour to an hour. That action can be accelerated by sunlight, so that we have at our disposal a simple means of testing the presence of iron in a deep well water.

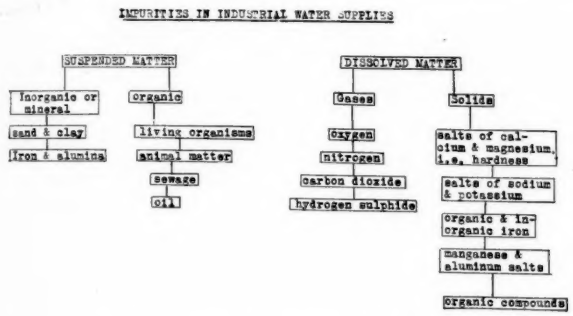
Troubles from Impurities

We are more or less familiar with the difficulties that are encountered due to the presence of these various impurities. I shall refer to them particularly, as they cause difficulties in the textile industry.

The suspended matter, of course, is objectionable in textile work because it prevents the production of a clean product, and therefore it is always necessary to remove it if one wishes to obtain the best results in the process work.

With the dissolved matter, among the gases, the oxygen is rather objectionable, because it is the principal

cause of corrosion in pipe lines and boilers. Oxygen has not yet been economically removed on a large scale, so that it pays to treat the entire water supply; but for boiler-feed purposes it can be readily removed by simply heating the water to the boiling point, at which temperatures the gases are rendered insoluble; and if the heater is provided with a vent they pass off to atmosphere. In



that manner the oxygen is removed from the boiler-feed water, and the water will then not corrode the boiler.

In the past the carbon dioxide has been believed to be the cause of corrosion, but many investigations which have been recently carried on have proven that the principal factor is the oxygen, and that the carbon dioxide, if present in addition to the oxygen, may simply accelerate that corrosive effect; but the carbon dioxide itself does not cause corrosion.

Referring now to the group of dissolved solids, we have the substances which most commonly occur in natural water supplies—the salts of calcium and magnesium, which are known as hardness. These, as we all know, cause a number of great difficulties in the textile industry. We know that wherever soaps come in contact with lime or magnesia salts the insoluble precipitates are formed, and where such insoluble soaps are formed they immediately attach themselves to the fibers and adhere. During all the subsequent process these soaps interfere with the quality of the product.

It is also true that these calcium and magnesium salts form insoluble compounds with many classes of dyestuffs, and with such dyestuffs the adverse effect of the presence of lime and magnesia is noticeable immediately. With the other dyestuffs that do not form the insoluble compounds the actual precipitations do not occur in the dye baths, but these insoluble soaps which have attached themselves to the fibers in the previous processes (the soap-scouring processes) interfere with the even dyeing in the actual dyeing work.

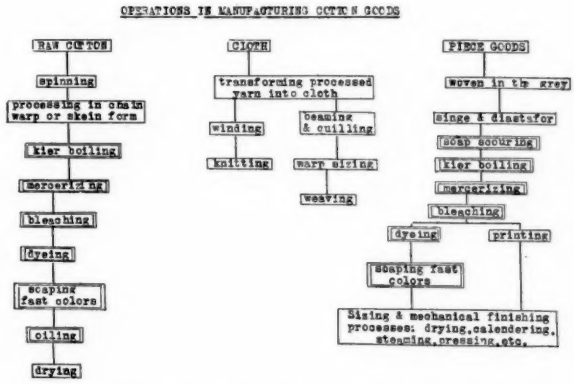
In feeding boilers with hard water the formation of scale, with its attendant fuel losses, is well known. Furthermore, the presence of the scale is dangerous, because it often causes bagging and blisters on the tubes. Such blisters are usually caused by the presence of scale on the interior of the tube, which requires a higher temperature in the fire, and sometimes this temperature becomes so high that the metal actually becomes fluid, and in such cases, at the points where the metal becomes hottest, the pressure in the interior of the tube forces the metal out and makes a blister; and, of course, in many cases it actually becomes a rupture.

Here are a few process diagrams which I have made up to illustrate the various processes in the branches of the textile industry; you will note that there is a double line around those where water is used—that is, the wet processes.

Water in Cotton Processes

Referring to the cotton diagram (chart showing operations in manufacturing cotton goods), the first wet process is kier boiling, where it is absolutely essential to have a water that is clear and free from hardness, because the cotton packed in the kier itself acts as an excellent filtering medium for any suspended matter which may be present in the water supply. Any hardness present will form insoluble soaps in suspension, and these will be filtered out by the cotton pack as the liquors circulate through these, so that when the cotton is taken out of the kier there may actually be a layer of these suspensions on the surface; and it is usually found that the cotton which is the worst is that on the top and near the sides of the kier.

Even in the kier boiling with caustic soda alone you



form these insoluble soaps where there is hardness present, because in those pectins which constitute the wax on the cotton there are also fatty acids, and these fatty acids react with the caustic soda to form soaps; that is, the sodium compounds of the fatty acids are the soluble soaps, and these soluble soaps react with the lime and magnesia present to form the insoluble soaps. So the kier boiling, which is the foundation for good work in the rest of the cotton mill, is one of the most important

steps in the manufacture where it is necessary to use absolutely clear soft water.

In the mercerizing, which is the next process in which the water is used, it is not absolutely essential to have a soft water throughout. For the caustic immersion I believe that a soft water is of great advantage, because if there is any hardness present you may get some insoluble deposits on the surface of the yarn. If there are such deposits it prevents an absolutely even penetration of the caustic liquors. This means that the yarn or cloth is not evenly mercerized, which in turn means that the dyestuff will not be evenly absorbed when that yarn or cloth is later dyed.

I know of actual cases where streaky dyeing in mercerized yarns and cloths has been eliminated by removing the hardness from the water used for the caustic immersions and for the rinses immediately following.

In the bleaching—that is, the applications of the chemic, which is usually an alkaline solution of sodium hypochlorite—there is again danger of precipitations on the yarn, and it is advisable in the bleaching process to use water that is clear and free from hardness.

In the dyeing process in cotton many of the dyes, particularly the substantive or direct colors and Indanthrens and some of the vat colors, form insoluble compounds with the lime and magnesia salts, and it is therefore essential to have the water absolutely free from hardness for those processes. Furthermore, in those classes of dyestuff which form these insoluble compounds with the lime and magnesia salts great economies are experienced by removing even the small amount of hardness from the water. This is of particular advantage in dyeing absolutely fast colors with the Indanthrens, because some of these dyestuffs are very expensive. Similarly, these fast colors are usually soaped after dyeing; and for that soaping work, as usual, it becomes necessary to avoid hardness.

In processing in cloth form the same facts prevail for the soap scouring, kier boiling, mercerizing, bleaching, dyeing and soaping as those described for yarns above.

Water in the Woolen Mill

Here we have what appears to be more mechanical steps in the manufacture, but at those points where water is used it is absolutely essential to have a water that is free from hardness. Take the scouring of the raw stock; I can't think of any other point in the textile industry where it is of more importance to have a clear, soft water, because there you have a hot alkaline-soap solution and the woolen fiber itself has the fir-cone structure. We all know that in hot solutions precipitation takes place much more rapidly and more completely, and these deposits are caught in the woolen fiber and are held fast. This means, of course, that we are going to have these deposits to interfere with all the future processes, aside from the fact that tremendous quantities of soap and soda are wasted here.

With the basic dyestuffs it is absolutely essential to have soft water, because the basic dyestuff as a class combines with calcium and magnesium to form the insoluble compounds, and the economies that result from the use of soft water here are great.

Carding and spinning are merely mechanical processes, but these mechanical processes in wool show up very strongly the effects of either bad or good scouring. Often, if you have a wool which is scoured in hard water you will find that the little teeth in the cards become clogged from collecting the soap deposits that were on the surface of the fibers.

In the finishing plant the processes involved are the same as those discussed above for stock and yarn scouring and dyeing.

In the silk soaking before the reeling it is a known fact that if any calcium or magnesium is present the silk fiber absorbs it, and this hardness makes the fibers brittle so that they break in the reeling. The same applies to the soap and oil soaking which precedes the throwing, except that here you have also the opportunity for forming those insoluble soaps, and this prevents the fiber running smoothly when the silk is thrown and increases the breakage tremendously.

In skein processing, the degumming for the removal of the sericin from the silk is carried out by immersing the silk in a soapy solution at the boiling point for anywhere from thirty minutes to a few hours, depending upon how far the degumming is to be carried and the quality of the goods being degummed.

Where hard water is used, attempts are made to soften the water in the degumming vats by the use of soda ash in connection with the soap. Of course, that sort of treatment in the vat is usually carried out very empirically. A man throws in so much soda ash, and he may add not quite enough or he may add too much. Frequently he adds too much, and the result of having free alkali in the silk-degumming bath at boiling temperature is disastrous. As you know, the silk is affected by alkalies and the luster is deadened, the fiber becomes more brittle, the feel is spoiled and the color is made yellowish.

Where you have water absolutely free from hardness, it is unnecessary to use anything else in the degumming process except the pure olive-oil soap in the water; the gum is removed and the fiber resulting therefrom is soft and clean.

In tin weighting, the actual weighting solutions themselves—that is, the stannic chloride which is applied to the silk—do not cause any precipitation, because the stannic chloride is an acid solution; but if the silk coming

from the degumming bath has these precipitates all over it you will not get an even absorption of the tin salts, and as a result of that the tin will not be fixed evenly throughout the fiber. Then, when the skeins are dyed, the portions of the fiber which were not penetrated with the tin will not take that dyestuff as readily as those portions which have the advantage of the mordanting effect of the tin, and as a result of that you will have what are frequently referred to as "hungry spots" in the dyed silk goods—that is, spots which have not taken the dyestuff as well as those parts that had the tin in them.

In the phosphate washes after the tin is applied it is

CHEMICAL REACTIONS IN WATER PURIFICATION

Alum Coagulation

$$3\ Ca(HCO_3)_2 + Al_2(SO_4)_3 \longrightarrow 2\ \underset{\text{floc}}{Al(OH)_3} + 6\ CO_2 + 3\ CaSO_4$$

Lime-Soda Softening

$$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2\ \underline{CaCO_3} + 2\ H_2O$$

$$MgSO_4 + Ca(OH)_2 \longrightarrow \underline{Mg(OH)_2} + CaSO_4$$

$$CaSO_4 + Na_2CO_3 \longrightarrow \underline{CaCO_3} + Na_2SO_4$$

Zeolite Softening

$$Na\ \text{zeolite} + \begin{matrix}Ca\\Mg\end{matrix}\ \text{salts} \longrightarrow \begin{matrix}Ca\\Mg\end{matrix}\ \text{zeolite} + Na\ \text{salts}$$

Regeneration

$$\begin{matrix}Ca\\Mg\end{matrix}\ \text{zeolite} + NaCl \longrightarrow \begin{matrix}Ca\\Mg\end{matrix}\ \text{chlorides} + Na\ \text{zeolite}$$

again necessary to use a soft water, because sodium phosphate will precipitate in the soluble phosphates of lime and magnesia.

It is clear that in each branch of the industry water is used in fundamental processes which affect practically all of the subsequent processes in the manufacture.

Principles of Water Treatment

In order to cover what may be familiar ground to many of you, I thought we would put these chemical reactions on a chart. These chemical reactions cover briefly the principles involved in the various methods of water purification. [See chart above.]

The first reaction which you see up here (the alum coagulation) is the treatment commonly used in connection with mechanical filters for the removal of suspended matter. The natural bicarbonates in the raw water react with the alum or sulphate of alumina to produce the aluminum hydrate or floc, plus CO_2 and some calcium sulphate. It is this floc which attracts to itself the finely divided suspended matter and the color in the water, thereby converting these finely divided and dissolved materials into a large particle which can be readily strained out of solution by the filter. We will go into the apparatus and applications of these principles later.

The next reaction illustrated is softening by the lime-soda process. The bicarbonate of calcium is precipitated by the addition of calcium hydrate of lime, to form the insoluble calcium carbonate and water. The insoluble calcium carbonate settles out, and that remaining in suspension is later removed by a filter.

The calcium sulphate, plus whatever other soluble calcium salts there are in solution, reacts with the sodium carbonate to form the insoluble calcium carbonate and the corresponding sodium salts. The magnesium salts react with the calcium hydrate to form insoluble magnesium hydrate. Thus, the insoluble compounds formed in the lime-soda process are calcium carbonate and magnesium hydrate.

The next reaction is that which takes place in Zeolite water softening. Here we have a mineral which is practically insoluble in water, and which is suitably supported in a container in the form of a bed. The water percolates through this mineral, and the reactions which you see here take place automatically. The sodium Zeolite, the insoluble compound, reacts with the calcium and magnesium salts, irrespective of which salts they are to form the calcium and magnesium Zeolite, the sodium salts passing on in the effluent. The sodium salts do not form any precipitates with soap—they do not react with any dyestuff to form insoluble compounds; and in boilers they do not form any scale. Water containing only sodium salts is, therefore, absolutely soft and eliminates the difficulties which were referred to under hardness.

As noted above, the principles of lime-soda softening involve the precipitation of these insoluble compounds. Therefore, the best that we can expect to produce in the effluent of the lime-soda softener is a hardness which is below the solubility point of these compounds. Take calcium carbonate, for example. Its solubility runs about thirty or forty parts per million, and therefore you are bound to have that much of the material remaining in solution after your reaction has been carried as far as it can be in the actual precipitation. Similarly, the magnesium hydrates has a certain solubility somewhere around twenty or thirty; that is, with the usual excesses of chemicals which can be present in water purification. So you have a total of anywhere from sixty to eighty parts per million of hardness passing out with effluent of the lime-soda water softener. It should be made clear that this amount of hardness remains in solution in the presence of the small excess of chemicals which is allowable in water treatment.

With the Zeolite softener, since your reacting mineral, the sodium Zeolite, is practically insoluble in water, you can have a tremendous excess of this material present without any of it going into the effluent. Consequently, you can carry this reaction to completion, all your calcium

and magnesium salts being removed, leaving the water absolutely free from hardness.

If an attempt is made in lime-soda treatment to carry the reactions farther, or if care is not exercised in the dosage of chemicals, the effluent may contain excesses of these soluble chemicals, which is a very dangerous condition for textile process work. This cannot occur with the Zeolite softener, because the softening medium is practically insoluble in water.

After the Zeolite has been completely exchanged—that is, after it has absorbed all the lime and magnesium salts which it can—it is regenerated, which means bringing it back to its original condition by treatment with a solution of sodium chloride. That simply reverses the reaction.

Principles Applied to Equipment

A number of years ago the common method of removing the suspended matter, and even color, was slow sand filtration. In this system the sand used was of very fine size and the rate of filtration was very low. This practice called for larger filter area, and the initial cost on such plants was therefore high, the space requirements were great and manipulation difficult.

The removal of fine turbidity and color with larger sized grains of sand, and therefore at higher filtration rates, was made possible by the introduction of coagulants. This scheme of pre-treatment before filtration made it possible to use the coarser sand and to step the filtration rates up to about 2.5 gallons per square foot per minute, so that the filtration areas, the ground space and the initial costs were decreased tremendously.

Incidentally, the average rates in the slow sand filter plants were about one-tenth of a gallon per square foot per minute. That is about one twenty-fifth as fast as the rates used in rapid sand filtration. Consequently, the area required to filter a given number of gallons in a unit of time by the rapid sand filters is about one twenty-fifth as great as the area required by the old slow sand filtration methods.

These filters operating at the higher rates of filtration are called mechanical filters to distinguish them from the slow sand filters. Coagulation has made mechanical filters possible, because the floc absorbs fine turbidity and color and holds them in the form of a large particle which can be completely and readily filtered out by the coarser sand. If this fine turbidity and color were not coagulated before filtration, most of it would pass through the interstices between the sand grains and appear in the effluent of the filter.

The coagulant most commonly used in water purification at the present time is sulphate of alumina. For complete coagulation it is necessary to allow the coagulant to react with the water some time before admitting the water to the filters. The practice on industrial purification has been to allow a coagulating period varying anywhere from four hours down to nothing. Since the formation of the floc requires some time, it cannot be expected to produce the best results without some coagulation period. Furthermore, the use of the settling basin before filtration reduces the burden on the filters, because much of the suspended matter and the coagulant settle to the bottom of the basin, and it is then only necessary to filter out the residual floc in suspension.

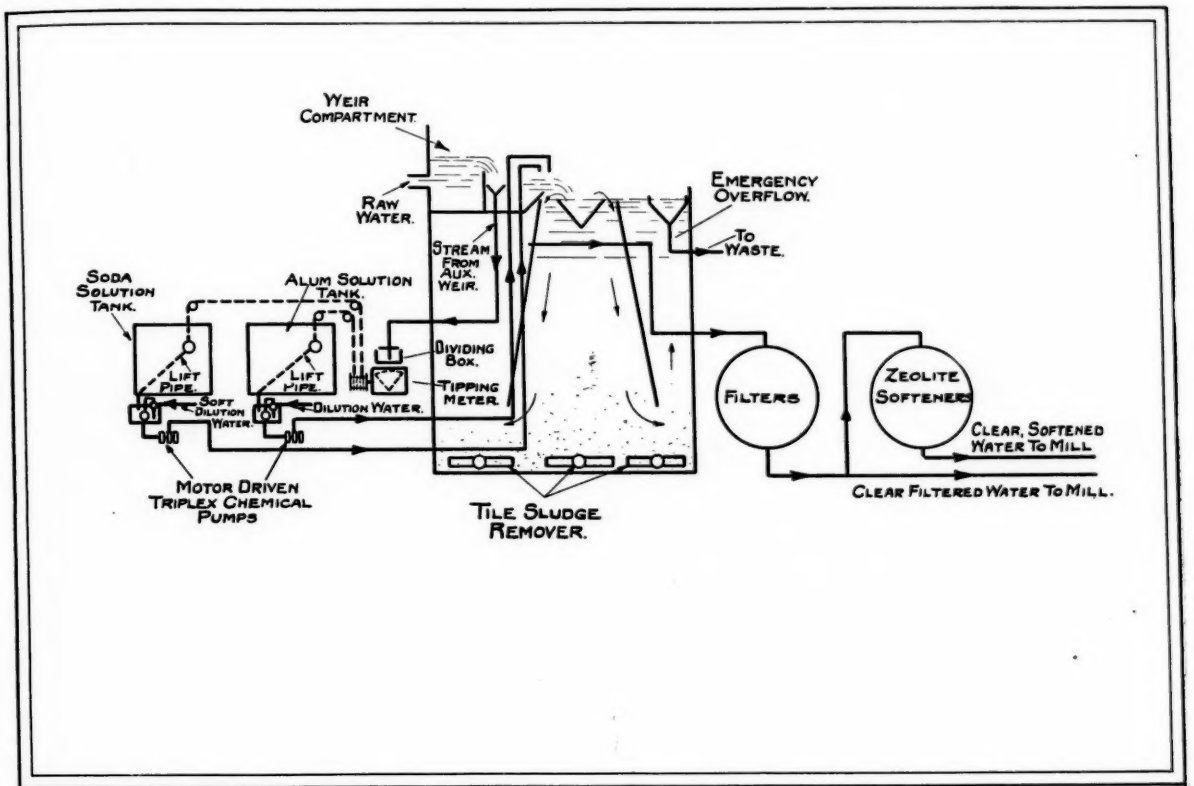
Much progress has been made lately toward improving coagulation results and cutting down settling periods by the proper chemical adjustment. It was only very recently recognized that too much alkali in coagulation is just as bad as too little, and that the best coagulation takes place between definite limits of alkalinity and acidity.

You will recall the chemical reaction where the alum reacted with the bicarbonate in the water to form the insoluble floc. If you had a water like many of these Southern waters, which are very low in alkalinity and high in color, and needed a considerable amount of alum to coagulate that color; if you added the alum directly to the water without adding any alkali to form the floc, the alum would simply go into solution and would give you a water containing the acid salt in solution. Such a water would be detrimental to the piping systems; and when it got into some of the dye baths where soaps or alkalies were added, or into the scouring processes, it would give a very bad result.

In order to avoid this it is necessary to give the alum the alkalinity which it needs. This is done by feeding soda ash when the alkalinity is too low. There is a definite ratio between amount of alum fed and amount of alkalinity required, one part of alum sulphate requiring one-half part of Methyl Orange alkalinity. Thus, by analyzing the raw water and knowing the amount of alum which must be fed, you can readily determine whether you have to feed any artificial alkalinity to get your reactions complete.

In former times, if the alum coagulation was incomplete it was the custom to add more soda ash to improve the coagulation. This was often unsatisfactory, because excess alkalinity can do just as much harm to the coagulation as insufficient alkalinity. That is a point which is just beginning to be recognized; and, as a matter of fact, I have been many times surprised at the number of large plants which are operating at this very day with improper dosage of the alum and alkali, and which are losing the benefits of large and expensive filtration systems just because they don't know anything about that adjustment—or if they do know it they are overlooking it.

It has been claimed that better results are produced with gravity filters than with pressure filters, but in these



FLOW DIAGRAM
OF
TYPICAL
PRESSURE FILTRATION AND SOFTENING PLANT.

comparisons the error has often been made of comparing properly designed and operated municipal plants of the gravity type with improperly designed and operated industrial plants of the pressure type. There is no particular reason why the mere application of pressure should affect the quality of the effluent of a filter, provided the pre-treatment and rates of filtration are the same in both cases. It is true that the pressure filter can be abused by forcing water through it at a high rate, but if the plant is properly designed for the maximum capacity required there is no danger on this score. The great advantages of pressure filter plants for industrial purification are the much lower initial cost and the elimination of repumping, with the accompanying loss of power that is often required by the gravity installation. Furthermore, the flexibility of the pressure plant to deliver unexpected capacities is a distinct advantage in industrial work, because the danger of small amounts of bacteria slipping through the filter is of no concern as it is in the case of municipal filter plants.

Construction of the Softening Plant

We pass from the subject of filters to the apparatus used in water softening. At present there are two principal methods of removing hardness from water: the lime-soda and the Zeolite. Lime-soda plants, by the way, are getting to be obsolete in the textile industry because of the objections which we considered before, but we will go over the general construction of such a plant briefly. [A description of plant followed.]

The principal objection to lime-soda treatment for textile work is that at best it produces a 5-grain effluent which is harder than many of the Southern supplies that are being completely softened to advantage by the Zeolite process. Furthermore, the lime-soda plant requires chemical skill for its operation, particularly on a variable water supply. Also it requires large amounts of ground space and involves the danger of excess chemicals in the treated water.

In the Zeolite softener the water just percolates through

the Zeolite. By the time it reaches the strainer system the calcium and magnesium salts in the water have been completely absorbed and passed out to service. When the capacity of the Zeolite softener is exhausted, as indicated by a meter, these inlet and outlet valves are shut down.

After the short period of back-wash the valves are closed again and the brine inlet valve is opened.

After the regeneration is completed, we have one more step to go; the raw water inlet is again opened, the exhausted brine is rinsed out of the bed to waste until the water coming out of the waste valve is free from hardness as indicated by a simple soap test.

The operation of the Zeolite softener is very simple. The capacity of such a softener is the product of the volume of water treated by the hardness of that water; and there is never any danger of overtreatment, because the mineral is insoluble in water. This also makes it possible to have a great excess of mineral present so that the hardness can be completely removed. Furthermore, these plants are very compact and can be directly connected into a pressure system without the need of repumping.

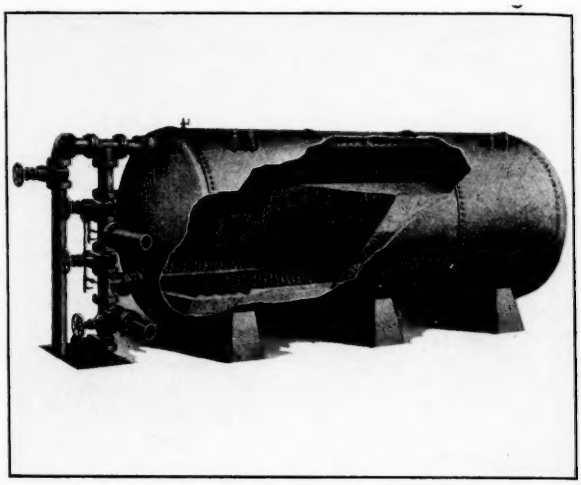
There are at present two general types of Zeolite which are being largely used: the porous and the non-porous. The porous Zeolite has the advantage of having a slightly higher exchange value; that is, it can absorb more hardness before its capacity is exhausted. On the other hand, the porous Zeolite is more easily affected by aggressive waters or waters containing small amounts of suspended matter, because the pores become clogged up with suspended matter and thereafter the capacity of the Zeolite is considerably reduced. Consequently, when the water is fairly aggressive or contains slight amounts of suspended matter, as most of our Eastern and Southern city water supplies do, it is advisable to use the non-porous Zeolite; which, I say, has the lower reacting power and therefore requires a slightly larger shell, but which, on the other hand, is more rugged, so that it can resist the action of these suspended matters or the aggressive qualities of the water.

Outside of that, the principles of the two Zeolites in the softener and the softener itself are identical. The only difference is that, on account of the lower exchange value of the non-porous material, the solid Zeolite, you need a larger container to get the same capacity.

Another advantage of the solid Zeolite is that it can be regenerated with the brine very rapidly—in fact, almost instantaneously—because all the reactions have taken place on the surface of the particles, whereas in the case of the porous Zeolite the reactions have gone into the interior of the pores, and consequently the regenerating period which must be allowed is also greater in order that the brine can reach the interior of these pores.

Advantages of Uniform Soft Water

One of the principal features of the Zeolite softener is that it produces a uniform water of zero hardness, irrespective of the hardness of the raw water. Such typical variations as that in the hardness of the Delaware River supply show why unexplainable mysteries frequently arise in the textile mill where unsoftened water is used.



Horizontal Filter, Showing Interior Construction

This is a simple graph [showing chart] of the hardness of the Delaware River water taken down at Chester, Pa. The months are represented along the abscissa and the ordinates represent the hardness. As you see, the hardness of that supply runs from 30 to 160 parts per million expressed as calcium carbonate.

You can well imagine what happens to the scouring formulae and the dyeing formulae in a mill when the hardness of this water supply, which forms these insoluble compounds, is varying as erratically as illustrated there. Of course, with the Zeolite softener that hardness is completely removed, so that the effluent is absolutely uniform in composition irrespective of the hardness of the raw water entering the softener. As long as the capacity of the softener in total number of grains has not been exceeded, the water coming out is absolutely soft.

There is a great amount of specific data available illustrating the advantages and economies of using absolutely clear soft water in the textile mill, even where the untreated supply is comparatively soft. It should be borne in mind that the cost of installing and operating the Zeolite softener is practically in proportion to the hardness of the water being treated, and therefore the economies effected show excellent returns on the investment for comparatively soft waters as well as for the harder supplies. None of the specific data showing these actual

economies in practice has been presented this evening, because practically all this information is of an empirical nature and is only of interest as it can be borne out by the facts and figures available in mills where such systems are in operation. The reliable manufacturers of water purification apparatus are always ready to place these facts and figures at the disposal of any who care to investigate them, and the great numbers which have been satisfied with the results of such investigations is proven by the continuously increasing number of modern water-purification plants installed for textile purposes.

The Engineer in Finishing and Dyeing*

By Warren B. Lewis

THE engineer is something of a dreamer. His mind is free of tradition, custom, and to a certain extent human experience.

If the engineer needed a slogan it might be: "find the better way." He is essentially a person of discontent, dissatisfied with things as they are even though they may be of his own creation. He is not bound by man-made laws in his fundamental reasoning, in which respect he differs from the lawyer. Everyone knows how to use a screw driver, and is, therefore, a competent critic. Almost everyone can understand his language and can reason and argue with him. The lawyer clothes his opinion in language which no one can understand, and, therefore, is reluctant to question. The lawyer's opinions and acts are based on man-made laws which are simply accepted custom, and the older the custom the better the law. Furthermore, the lawyer can interpret the law to more or less suit his convenience.

The physician deals with human life and the rest of us are loath to either deny or affirm his diagnosis. If the physician says that your appendix should be removed, you do not say that you will continue to use it for awhile longer because you have not yet written off 100% depreciation.

Perhaps it is well that the engineer is easily understood, else he would be changing methods and means so rapidly that nothing would ever become established.

An executive once told me that he had no doubt an engineer could plan for him a plant in which every machine and every process would operate at the highest possible efficiency, but when the plant was finished there would be no working capital left to do business with. Perhaps this is why men who are 100% engineers are poor executives. The engineer's path might be an easier one to travel if his methods of reasoning and his acts were better understood.

It is with some timidity that I stand before a group of technicians and artists in the finishing industry and attempt to instruct them in any phase of the mechanics of that industry. Although having been closely identified for twenty-five years or more with the business of producing finished fabrics, and having had the closest association with not only executives but the workers, I believe that there is no other man in this room who knows less about color and the chemistry of printing and dyeing than I. It is with the hope that many of you have been so busy pleasing the ultimate consumer and that you have had little time to give thought to the mechanics of your work that I have courage to discuss any phase of it.

The Demands of the Consumer

Perhaps no other industry, unless it be that of making jewelry, is so affected by the mental processes of the ultimate consumer, or if you like by the lack of mental processes; and I admire the agility of the designer and the colorist in his ability to leap from peak to peak and still keep his feet firmly planted on the ground.

Never before has the demands of consumers placed such a burden on the designer and manufacturer. The whole cotton industry has been tremendously affected by this change in demand, and the wool and worsted manufacturer is suffering from the same causes. A friend of mine who sells worsted goods answered my question as to why the worsted mills were in such a depressed condition. He said that the principal reason was that whereas it used to take the wool of one sheep to clothe a woman it now took the silk of one worm.

If I have any quarrel with the manufacturer it is because he is loath to improve the mechanics of his business and too frequently makes progress only when forced to by circumstances. There are manufacturers who believe in leading the procession and are always a year or two ahead of their competitors in demanding the better way. These leaders can generally be picked out in any industry and they are also generally the most prosperous.

The cost and speed of producing are much more important factors than they ever have been before. The order of the day is high labor cost with low selling price, and I do not know how these two conditions can be met unless it is through the perfection of mechanical means.

In the earlier days of mercerizing, the recovery of caustic soda was not attempted. I remember talking with an executive of a finishing plant to interest him in this idea and he laughed and said that he was much more interested in a proposed tariff revision that would increase the selling price of mercerized goods one cent a

*Paper delivered at the Summer Meeting of the Piedmont Section, Charlotte, N. C., July 13.

yard. When that particular tariff came up before Congress the whole process and cost of mercerizing was brought into the open, with a result that there was no increase and the actual state of affairs was made plain to the customers.

Problems Largely Mechanical

To-day competition is too keen to permit of waving aside any mechanical improvement which would reduce cost and make possible quick deliveries. I do not labor under the idea that the engineer is the savior of industry. I believe thoroughly in the super-importance of the chief executive and in the skill and wisdom of the plant manager, and believe that the engineer should provide the helping hand and devise the means whereby manager and executive can comply with the demands of the ultimate consumer and trade conditions generally.

An acquaintance of mine who was educated in one of the large technical schools and who was financially interested in a finishing plant once told me that 90% of the problems in the finishing of goods were mechanical and that, if machines were right and the processes reduced to formulas, results could be predicted with accuracy with very little technical skill so far as management was concerned. I have always regretted that he did not put this idea into full force, because I think he would have produced a greater variety of finishes than even you could devise; and as that seems to be what the consumer wants, I think the idea would be well worth trying.

I did not come here to indulge in oratory and to tell a few stories or utter a few platitudes in the manner of the after-dinner speaker, but rather to reminisce a little, advertise the engineer a little and to offer a few suggestions that may be worth your thought and consideration.

In the early years of my association with the finishing industry I was impressed with the importance of heat in the inclusive sense. Heat includes the power to move machines, to pump water, compress air, to carry on boiling and drying operations, warm, light and ventilate buildings. All of these items are simply subdivisions of heat in the fuel, whether burned under boilers in a plant to provide all heat or whether part is purchased in the form of electric power. I was interested in trying to find a method by which the plant manager could know at all times something of the mechanical efficiency of his plant, so that knowing the rate of production he would know how much heat in the inclusive sense should be provided. The first step was to find the ratio between the unit of goods processed to a pound of coal or a gallon of oil, which was done by working with records over a period of two or three years.

It at once became apparent that the item of "heat overhead" (if I may call it that) was very large. Suppose that at some moment in your plant every man was stricken with paralysis and every machine suddenly stopped. Production would be zero, but the heat used would still be great. In fact, in several plants I found this to be nearly 70%; so that when production was, say, 25% of the maximum, the heat cost was no inconsiderable item. I found it possible to establish a graphic chart which would show the actual cost of heat for each rate of production in steps of approximately 100,000 yards a week, and it was at once apparent that any steps taken to reduce the "heat overhead" would bring about a more favorable ratio under average conditions, and particularly when plants were running at low production.

A Bird's-eye View Through Heat Charts

Such a chart as this not only gives the manager a bird's-eye view of the situation but provides the means whereby the use of heat in the inclusive sense can be reduced through departments and in individual machines. In one large well-known plant such a chart became the basis of a bonus paid to the mechanical department, with rather outstanding results. Of course, the total cost of heat in a finishing plant is not a great percentage of the total cost of operation, and that is where too little thought is given to it. We are too apt to think in terms of percentage rather than in terms of dollars and cents, and $10,000 or $25,000 is worth saving whether it is 5% or 25% of the total cost.

I am going to start at the beginning and speak of some of the errors of design and use in the older plants and of what modern developments have made possible. Twenty-five years ago many of the machines in finishing plants were driven with small steam engines, these being used principally where varying speeds were required, such as mercerizing machines, driers, printing machines, tenters, agers, etc. In these plants there would be a central prime mover driving constant-speed machines through shafting or belts and generators and motors, these prime movers exhausting their steam to a condenser or the atmosphere with a loss of 90% of the heat delivered to them. The small engines frequently exhausted to machines driven, and it was supposed that the heat balance was all that could be desired. As a matter of fact, a very large part of the heat developed in the boiler room was lost to condensing water through radiation and condensing losses in small engines, long pipe lines and multitudinous leaks of one kind or another.

Before the advent of the variable-speed motor this arrangement was perhaps necessary and should not be too severely criticized; but with the development of the variable-speed motor it became possible to generate all

power in one central unit, the exhaust steam from which could be utilized for process purposes with a total recovery of 80% of all the heat developed in the boiler room in the form of steam. A development of this plan has made it possible to provide all of the mechanical power required in finishing works at a cost less than it can be provided in any other way, the actual fuel cost being almost negligible.

The ideal design is one in which the power plant is of such characteristics that all of the mechanical power is produced with a weight of steam insufficient for processing, so that at times of low production there will still be a high percentage of recovery. This has been made possible through the developments of recent years, not only in boiler and turbine efficiencies but in the application of heat to processing. Fundamentally the machines in a finishing plant should be so equipped and operated as to use the smallest possible amount of low-pressure steam, and then as much power should be developed through the use of this steam as the plant may require. In a number of instances it has been possible to produce more power than the plant required, and the surplus could have been sold had there been any market for it.

Boiler Plant Efficiency

To begin with, not only the older boiler plants but the majority of those in finishing plants to-day are made up of a considerable number of units hand-fired, with heat efficiencies of 65% or less and relatively high labor costs. To-day it is possible to operate boilers at sustained efficiencies of 80% and greatly reduced labor costs. One plant with which I am familiar has recently replaced twelve boilers with two, eight firemen and helpers with two, and a total reduction in all items of cost amounting to a rate of interest not to be considered inconsequential.

The modern boiler plant which has come out of research laboratories of the public utilities is a very different affair from the old plants. It has been found that the limiting feature was in the furnaces rather than in the boiler, and that the latter could absorb heat at an enormously increased rate if the heat could be properly applied to it. At the Hell Gate Station in New York a 1,000-h.p. boiler has become a 6,000-h.p. boiler, which is perhaps rather extreme, but in many industrial plants a good boiler may be operated at twice its normal rating continuously at high efficiency.

Increase in steam pressure has greatly increased the available power from prime movers for a given weight of steam passed through. Pressures of 400 pounds are becoming more and more common, and turbines which but a few years ago used 16 pounds of steam per kilowatt-hour now use 10. In the finishing industry non-condensing units are the logical type of prime mover, and these higher pressures have increased the power output per pound of steam so that the most desirable heat balance in the plant as a whole can be realized.

Time will not permit of describing in detail these improvements, and I must pass on to offer you a few ideas, some of which have been realized and some of which have not. Many of the processes which have been carried on with live steam can be carried on with low-pressure steam. In the worsted industry it was not thought possible, and many of the older dyers still think it impossible to boil a dye tub with steam at 5 pounds pressure just as satisfactorily as with steam at high pressure. Dye jigs and dye boxes of all kinds will work satisfactorily with low-pressure steam. In fact, in a well-equipped finishing plant I believe that very little live steam is needed for process work, and only where high temperatures are involved.

Saving on Steam

A number of years ago I made a study of kiers and tested practically every known type. The amount of steam used was carefully measured, liquors analyzed every hour and samples taken every hour for change in color. It is possible to carry on the operation of kier boiling with low-pressure steam up to 60% of the entire amount of steam used by pre-heating the liquors and by circulating independently of all heat reactions. This reduces the peak loads, which frequently determine the maximum capacity of a boiler plant.

All drying operations can be done with steam at 5 pounds pressure without loss of speed if the machines are properly designed for the work. In connection with this item of drying I call your attention to the inefficiency in operation of the ordinary set of drying cans.

The paper manufacturer learned a long while ago that the rate of drying was affected by the vapor tension in the immediate vicinity of the paper. Paper driers are very expensive machines and must be operated at maximum capacities. If the vapor tension is reduced by removing the moisture-laden air in the immediate vicinity of the paper, then there is an increase in the rate of drying per square foot of drier. The paper manufacturer also learned that the removal of great quantities of moisture-laden air resulted in the introduction of an equal volume of dried air which was necessarily heated to room temperatures in one way or another. You are all familiar with foggy conditions around driers and know that the removal of moist air by ventilating fans results in the drawing in of air from some source which frequently aggravates the condition. There is a device used in the paper industry, called the Briner economizer, by means of which the heated air from the driers warms incoming

air from out-of-doors and delivers it into the machine room.

A more recent development has been the Minton vacuum drier, a most ingenious machine, consisting of driers enclosed in a cast-iron housing and sealed against incoming air. In this housing a vacuum of 28 inches is maintained, the paper is dried at temperatures of 100° F. at high speed, and the whole matter of ventilation is dispensed with. This machine uses about half the steam of an open drier, and I believe that it has great possibilities in the textile industry, particularly where heavier goods are concerned.

The recovery of caustic soda involves the use of considerable heat, and its application is dependent upon the percentage of goods mercerized. The cheapest recovery is where all of the caustic which can be washed out can be used in kiers; but if a large percentage of the goods is mercerized, then recovery by evaporation is the logical consequence, and this is done with low-pressure steam.

Increasing the Production of Finishing Frames

The productive capacity of finishing frames is almost in proportion to the effective removal of moisture except for mechanical limitations on swing frames. The drying capacity of these machines is also a matter of vapor tension, and speedy removal of moisture-laden air is more effective than high temperature alone. There was a great improvement in these machines since forced air circulation was adapted to them, but too frequently the cost of the equipment has influenced the buyer. A tenter frame represents a comparatively large investment, and its capacity should not be limited by auxiliary devices. You are all familiar with the great loss of heat in practically every form of dyeing machine or boiling-off machine. This is difficult to control, although there has been fair success with automatic temperature regulators in some cases. I hope that someone will at some time devise an apparatus for recovering the heat from the vapors from these machines, making it available for heating water and, incidentally, removing one of the chief causes of deterioration.

Aside from the uses of heat in a finishing plant, the problems of machine production are of great interest to the engineer. Too many finishing machines limit the productive capacity of the man who runs them. Tool-machine users learned that high-speed steels resulted in an increase in both machine and man capacity, and no one could afford to-day to use the old methods. The automatic loom has increased the capacity of the weaver; the automatic screw machine is almost uncanny in its self-production.

Too many drying machines, for instance, limit the production of the attendant. The first cost of the machine is given undue importance. Sometimes the limit is due to too few driers, sometimes to the manner in which the machines are installed, and sometimes to the construction of the machine themselves. A good drier is so designed and built that it can be operated up to the maximum economical speed. I have seen driers that had to be shut down every two or three weeks that the bearings might be repacked, and I have seen driers that ran two years without repacking. I have seen driers that were limited in speed by mechanical construction, and I have seen driers with cut gears, ball bearings and erected on good foundations that could be operated at high speed continuously without distress.

Machine Cost Merits Study

I commend for your consideration a study of the relation between labor cost and machine cost as you will find it in your industry. There is nothing that interests the management so much as a proposal to reduce labor cost. Any device which will get rid of an attendant is welcomed. Frequently the machine cost is a much more serious item than the labor cost. An extreme condition is in the case of a boiler plant where the fixed charges and the operating charges may be some ten to thirty times the labor cost, and an increased efficiency of 10% would mean more than the elimination of all the labor.

The manager of a plant once asked me to pass upon the specification of a machine which he was about to install as the duplicate of a machine which could not keep in step with the rest of the plant. The decision had been made to purchase the new machine, but this was held off until a study could be made of the old machine. That study showed that the machine was producing 29% of the time and was not producing for 71% of the time because the attendants were moving material to and from the machine in a very crude way. A means of handling the material was devised which resulted in not purchasing the new machine and the capacity of the old one was more than doubled. If you add to the cost of a machine the value of the land, the floor space and all the auxiliary equipment involved in the operation of that machine together, and take a reasonable percentage for fixed charges, and then to this add all of the material used in operating the machine, whether water, steam, dyestuff, repair parts, etc., and add again the annual value of floor space auxiliary to this machine, you will find that in a great many cases the total machine cost deserves quite as much study and reduction as does the labor cost.

There are so many problems in a finishing plant that interest an engineer that they could not be mentioned at any one time. Automatic control of temperatures and speed is justified more often than not. The transporta-

tion of goods from one department to another, particularly in the older plants, is a fertile field for study. I recently visited a plant in which the total number of miles of travel had been reduced 75% through a rearrangement of machines and the introduction of a system of transport so as to make certain processes more continuous. One of your number is acquainted with a transport system where goods are pulled a quarter of a mile from a weave room to a finishing plant and pulled back in the dry form the same distance through a very simple system that was worked out without precedent and with much skepticism on the part of the management. The actual saving in cost of transportation in this case was 300% annually on the money expended.

Building on Extravagance

The prosperity of this country was built on a foundation of extravagance and waste. This has probably been true in the development of all newly opened regions, although there is one factor to-day which can probably never again be relied upon, and that is a large supply of labor at a very low wage.

Twenty-five years and more ago we tapped our natural resources with little regard to the future, we had an increasing supply of foreign labor at low wages, and the ratio of labor cost to material cost was far lower than it is to-day. There is a story that a textile manufacturer once saw one of his employees riding down the street of the village on a bicycle, in the days when bicycles were becoming more and more popular, and he turned to his superintendent and remarked that when employees could afford to purchase bicycles they were earning too much money. To-day we believe that the greater the earning power the greater the spending power, and the ratio of labor to material cost has risen sharply. In fact, the actual value of material in many products as they are sold over the counter is small. The value of the leather in a pair of shoes is so small a part of the selling price of the shoes that the difference in price between a full shoe of heavy leather and a woman's light-weight slipper is practically nothing. The actual value of the cloth in a suit of clothes is no great proportion of the final selling price.

This leads to a new principle of business economics, namely: that prosperity, instead of being based on extravagance and waste, must be based on true efficiency in the use of labor and material. Many mills which fifteen years ago were highly prosperous have closed their doors and liquidated their assets because they were unable to cope with increased operating expenses and a selling price which was not in proportion. The successful manufacturer to-day is the one who sees the new economic condition and does not fear the consequence but has the courage to prepare for it.

Perhaps by this time you are wondering just what kind of a finishing plant an engineer would build. I have sometimes wondered myself. I once asked a friend of mine who was the managing director of a large print works what kind of a plant he would built if he had half a million dollars to work with. He said that if he had half a million dollars and ever seriously considered building a finishing plant he hoped his family would lock him up in a hospital for mental diseases and make sure that he would never escape.

COMMUNICATION

Improving the Level Dyeing of Viscose Rayon

September 3, 1929.

Editor, American Dyestuff Reporter:

Dear Sir—Some months ago a method of aftertreating dyed viscose rayon with beta-naphthol and common salt for improving the uniformity of the dyeing was issued by Courtauld's, Ltd. [See Reporter, April 29, 1929, page 282.]

While the method seemed applicable to yarns or vessel-dyed piece goods, it seemed very unlikely to give beneficial results on the jig, and the writer therefore did not attempt to utilize this method for improving the uniformity of jig-dyed rayons. Quite recently, however, he was given to understand that some dyers were utilizing the method quite successfully for jig-dyed rayons and union fabrics, and it was instanced that very satisfactory dyeings could be so obtained with Chlorantine Fast Green BL, a notoriously poor color for uneven viscose. The writer thereupon carried out the following experiments on two all-viscose cloths:

First—Four hundred and fifty yards, being part of a 1,000-yard jig-dyed lot with very uneven filling ("barriness"), was run down dry into the boiling bath on the jig, containing 5 pounds powdered beta-naphthol and 5 pounds common salt to 60 U. S. gallons water. The cloth was given five ends, with the bath maintained at temperature of 190° to 195°, washed off with warm water and dried up. No improvement could be observed over the untreated portion. The goods were originally dyed brown with 2% Chlorazol Brown LF, 0.2% Pyrozole Orange G and 0.2% Direct Fast Black B.

Second—A 1,000-yard batch of rayon fabric (36 inches wide, 6 yards to the pound) was being dyed sky-blue with 0.5% Sky Blue FF and 0.075% Chlorazol Fast Violet 4BL, and it was observed to be very warp-streaky.

After dyeing to shade the batch was not taken off the jig but given the same treatment as in first method above. After drying up it was found that the goods were very uneven (warp streakiness), and if any improvement had taken place it was not sufficient to make the dyeing satisfactory.

It is possible that the method, or some modification, may work on the jig with some dyestuffs, and the matter seems of sufficient importance to invite correspondence in the REPORTER from rayon dyers who have tried this method of aftertreatment.

Yours very truly,

RAYMOND CURTIS,
Quidnick Dye Works, Inc., Quidnick, R. I.

ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

ALEX MORRISON,
American Woolen Co.,
Andover, Mass.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
PROFESSOR OF CHEMISTRY AND DYEING, LOWELL TEXTILE SCHOOL
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Published biweekly by
HOWES PUBLISHING CO., INC.
90 William Street, New York City

A. P. HOWES, *President* E. S. PREDMORE, *Secretary*

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XVIII September 16, 1929 No. 16

PROSPERITY AND THE TECHNICAL SCHOOL

Answering the Question, Why Is Business So Good?

THIS question, "Why Is Business So Good?", makes the headline of a bulletin issued last week by the La Salle Extension University of Chicago. Beneath the title are more questions that summarize the study of prosperity in America. "Our prosperity is very real," the subhead reads, "but somewhat puzzling—What unique factors in our situation are responsible?—Can it be our vaunted race?—Our tariff? . . ." And so on, naming other factors.

For the current year as a whole industrial output in the United States should be at least 8 per cent greater than in 1928, according to the Standard Statistics Company. "Stop and think what 8 per cent means," the La Salle bulletin continues: "That factories that were making 8,000 units are now making 9,000 units, and with little increase in overhead expense." Railroads are prospering; employment is good; sales volume is growing.

But what is chiefly so interesting to us in this very optimistic review is its analysis of the basic causes of American prosperity. We may get some of this important story also from these headlines: "Canada also prospers—But John Bull doesn't—Why is America so favored? Is it race and climate which are responsible? Northern Europe has the same race and much the same climate.—Shall we say 'it's the tariff'? Our heaviest traffic is on a free-trade basis.—Has Government aid produced this boom?—Or are instalment sales responsible? —Shall low cost of production get the credit? Industrial engineers point to the tremendous and rapid increase in production per man as the outstanding factor responsible for American prosperity.—No, low costs alone are not enough. Along with the low costs of mass production must go somehow the means for *mass consumption.*— The mechanization of industry has put millions of 'common laborers' out of work, but only to elevate them into the skilled labor classes.

"Business is now a profession. Searching further for the prime causes of why business is so outstandingly good in America," continues the La Salle University review, "can it be that the 'book l'arnin',' until recently so much despised by the 'practical' business men, is responsible? The business world has an elaborate and up-to-date literature of a very practical value. There are thousands of new books, and scores of business journals, some general, and more devoted to some particular industry. All, consciously or unconsciously, are educating their readers in business. . . .

"Having put this vast fund of information into the hands of men trained to appraise it and to conduct their businesses accordingly, may we not correctly estimate this increase in business knowledge as the fundamental cause of America's position?

"But knowledge without men is valueless," concludes the bulletin. "American business is in the hands to-day of a group of forceful leaders trained not only in the ways of business, but developed through the keen warfare of competition. The less skilful are dropping out of the race, leaving the leadership to that rather small group of men who are equipped and able to guide their businesses. . . ."

So the analysis of prosperity at last comes down to this factor of *men properly equipped!* Is this not an amazing conclusion? And how highly appropriate it is at this season, when all over the country schools and colleges are opening their doors to a new wave of eager students.

To be trained for one's work is mighty important to everybody, and regarded from a personal point of view there are few things more important. But there is a broader aspect than the personal view affords, and this aspect we have tried to show by quoting a business review which explains our national prosperity in terms of trained, forceful leaders.

The call for men equipped for their work grows ever more insistent in our own industry, the manufacture of textiles. Intense specialization in every step of textile processing, however, has also increased the demand for leaders who can manage the corps of specialists. But before the ability to manage a technical staff there must come, first, the ability to do some one kind of technical work very well, much better than the average; and this trained specialization must further be grounded upon a broad knowledge of many processes if the individual is some day to assume leadership in the textile industry. Men educated in the science of textile manufacturing, therefore, become our great need.

The relation between the technical institution and the prosperity of an industry is a close relation in the textile manufacturing field, for upon the technical schools we must rely for the next generation of leaders. The time is not far off when the business of making textiles will

depend even more heavily than at present upon the technical man's judgment, and technically trained chemists and engineers will sit on more directing boards than they do to-day.

A TRIBUTE TO AMERICAN CHEMICALS

EVER since the day that our chemical industry came of age it has derived a certain pleasure from recounting the story of its struggles against heavy odds. Now that chemistry has been accepted by the mass of people as a science of marvelous potentialities, especially when applied to manufacturing, we naturally like to tell the world that we have an industry of which American citizens can justly feel proud.

Our industry seems at times to feel that it may not be given full credit for its development and its achievements. There are, it is true, certain notions and beliefs current among the American public—indeed, perhaps among the public of many nations—which are false, and which stand in the way of our acceptance as the leading producer of chemicals in the world. One of these beliefs or notions is that Germany is far in advance of every other nation in chemical science. A great many people all over the world still believe that nothing of a chemical nature is of any value unless it is made in Germany.

Before proceeding with our theme it may be well to pause to make certain that readers understand one thing: we are not now referring simply to the dye industry or Germany's world position as a dyestuff producer; we are alluding to chemical products in general, to medicinals, to heavy chemicals, to metallurgical chemicals as well as dyes, though it would be as easy to make our point by restricting the comment to coal-tar chemicals.

Now, it is no longer novel to attack the notion of Germany's supremacy in chemical manufacturing. This has been done too many times in this country in the past few years, and so it becomes a tiresome story. We have not set out to join the multitude of those who have emptied barrels of ink in their efforts to convince Americans and the rest of the world that German chemical genius, great as it unquestionably is, does not stand alone; that Germany does not make all the best chemicals used in the world's industries.

But what we would like to do is merely to add to these arguments a bit of fact unearthed while reviewing a recent book issued by the Government on the American chemical industry. In the course of its account of our development as a leading chemical producer this book makes the statement, rather amusing and startling, that Germany buys a great quantity of chemicals from the United States. In the past twenty-five years, in fact, the Germans have trebled their purchases of American chemicals, until to-day Germany stands as the largest single market for our *coal-tar* products!

Let us, therefore, give Germany full credit for its high place in the world of chemical science and manufacturing. We should be the very last to deny that Germany knows what good chemicals are, for do not her industries take 10 per cent of our chemical exports? What greater tribute to the quality of our products than this can our chemical manufacturers receive?

A COSTLY RACKET

DYERS and printers, laundries and similar establishments in the vicinity of New York and Long Island have lately been the prey of a band of nine men who represent themselves as expert tinsmiths. They offer their services in refinishing machinery parts and metal equipment, copper dippers, baskets, cans, jig rollers or cylinders. The work may be done in good fashion, but their bill is likely to be outrageously high. If it is not paid they will take their case to court—and win.

Their method of working is clever enough to outwit the shrewdest. Our informant was recently approached by three members of the gang, who requested some small machinery part to be used as a free sample of their work. This they returned very skilfully refinished and accordingly received an order to re-tin a dyeing can. They evaded an estimate by asserting that the cost depended on the quantity of metal they used, which could not be calculated, they said, until the job was done. The work was delivered finished satisfactorily; then came the bill —$583. Estimates later obtained at tinning shops set the value of the work as low as $16.

When full payment was refused, various members of the gang called upon the firm and threatened legal action. One day, so our informant says, the entire nine tramped in and attempted to intimidate the man who had given them the order, in an effort to obtain payment. They are described as "a rough crowd, in appearance not unlike comic opera pirates."

They are winning their cases in court, either on Long Island or in New York City, and for this purpose have used the free services of a legal aid association. There is no firm name given, so far as we have been able to learn, but their business card gives the addresses 103 Maurice Street, Maspeth, Long Island, and 136 Essex Street, New York. Both addresses are spurious.

J. T. Wigington has resigned his position with the Textile Bag Manufacturers Association, of Chicago, to accept work with the Bureau of Agricultural Economics, U. S. Department of Agriculture in Washington. He will devote his time to developing new uses for cotton.

Mr. Wigington is well qualified for this work, having had a number of years' experience in practical cotton manufacturing, serving as assistant superintendent at the Lonsdale Mill, Seneca, S. C.; three years in the Co-operative Cotton Testing work of the Bureau of Agricultural Economics at Clemson College, S. C.; and for the past years he has been textile engineer for the Textile Bag Manufacturers' Association. Mr. Wigington graduated in Textile Engineering at Clemson College in 1923.

EXTRACTORIALS

Quality of silk in relation to the conditions of its use requires much further study. It has been aptly said that there is no reason to suppose that a silkworm has a lady's dress in mind when performing the synthesis of his useful product. Its adaptability to human uses is a pure accident.—*Silicate P's and Q's.*

The first reader in chemistry appointed in the University of Cambridge was Bishop Watson. He knew no chemistry, but, desiring the position, he managed to secure the appointment, and then proceeded to the study of his subject. It is said he became a good teacher and became so enamoured of his science that he never again entered the confines of his bishopric.—*J. W. Shipley, in Canadian Chemistry.*

A casual flipping of the leaves of this month's trade papers reveals the following standard houses with the words "Vat Dyes" prominent in their advertisements: B. B. & R. Knight, Fruit of the Loom—Amory Browne, Indian Head Broadcloth—William Simpson Sons, Simpson Fabrics—Manville Jenckes, etc. If houses such as these find it worth while to feature vat dyes, it surely indicates a welcome trend. May the tribe increase!—*Laundry Standard.*

A really good education is a handle that fits many tools. The trouble is that a lot of people get the handle but have no tools to fit it and no work in which the tools may be used.—*Harris-Dibble Bulletin.*

Real chemists have often made folks rich with their achievements, but it is against their scientific trend of mind to make promises. The ethics of the profession discountenance that. If there were no ethics, the real chemist would not know how to make glittering promises. He just isn't built that way.—*Arthur Maas, in Nation's Business.*

Research in pure and applied chemistry is barely possible without the foundation of post-graduate work. There is no better training offered to the young chemist who desires to pursue research than two or three post-graduate years devoted to the intensive study of a chemical problem in pure science under the direction of a trained chemist.—*Canadian Chemistry and Metallurgy.*

It is essential to get the spirit of co-operation instilled into any organization before it can reach high efficiency. The goal must be made clear to all workers and must be shown to be attainable and worth while. Their interest must be stimulated to a point where it will overcome every obstacle.—*Harris-Dibble Bulletin.*

LIGHT FASTNESS OF INK PIGMENTS STUDIED BY BUREAU

Exposure Tests Undertaken by Government Laboratory

Research tests on the relative light fastness of a number of ink pigments has enabled Government chemists working at the Bureau of Standards to classify these pigments on the basis of their resistance to daylight exposure. The current issue of the Bureau's Journal of Research contains a report on these tests and a tabulated classification. To quote from the text of a statement issued by the Bureau:

In this investigation, 136 specially prepared lithographic prints representing 31 pigments were exposed to daylight in several different ways, and to the light from a glass-enclosed carbon arc. Each sample was exposed for four different periods of time and, in general, so that slight fading occurred in the first period and decided fading in the fourth, and intermediate amount of fading in the other two. Seven sets of samples, all cut from the original prints, were exposed in the following ways: Set A and set K, only on clear days between 9 a. m. and 3 p. m., under glass, at an angle of 45 degrees from the horizontal, facing south; set B simultaneously with set A but with no glass cover; set D continuously under glass, vertical, facing south; set E, continuously, under glass at an angle of 45 degrees, facing south; set F, continuously, under glass, vertical, facing north; set G-H, in the "Fade-Ometer.

Although the majority of the prints showed the same relative fading in the series in the different exposures, a few faded decidedly faster and others slower than the average in certain exposure sets. The yellowing of the varnish vehicle in the absence of light, its bleaching in strong light, and the effect of heat on some pigments had to be taken into consideration in judging the fastness of certain prints. The carbon arc appears to be a reasonably satisfactory source of light for fading tests.

RAMIE YARN ON THE "GRAF ZEPPELIN"

Dr. Eckener's renowned flight around the world has focused our attention upon a unique function of Ramie yarn. Because of its tremendous tensile strength the builders of the *Graf* and the *Los Angeles* selected Ramie for the ropes that gird the huge gas bags on both the famous Zeppelins.

Indications are that the textile industry will continue to serve aviation in the future as well as it has in this last circumnavigation of the globe. The firm of Erste Deutsche Ramie Gesellschaft, of Emmendingen, Germany, manufacturers of this yarn, reports that Ramie will be used on the two new Zeppelins now under construction for the United States Navy. Erste Deutsche Ramie Gesellschaft is represented in this country by Pfaltz & Bauer, Inc., of New York.

THE BLEACHING OF SILK

(*Continued from page* 610)

For 50 pounds of tussah silk a bath is prepared containing 30 pounds of magnesium sulphate dissolved in 110 gallons of water, and the silk, after being well boiled off and washed, is thoroughly impregnated with liquor and then lifted from the bath while 6 pounds of sodium peroxide is carefully added in three portions during forty-five minutes, working the silk in the bath after each addition. It is very important not to neglect to impregnate the silk first with the magnesium sulphate solution, otherwise the luster of the fiber would be impaired by the strongly alkaline solution of peroxide sodium acting on the silk. After the final addition of the sodium peroxide, the bath is heated during forty-five minutes to 190° F. Dilute sulphuric acid is then added to clear the bath, which will have become milky through the precipitation of magnesium hydrate. The silk is then given two or three turns in this liquor, washed and worked for thirty minutes in a bath containing 30% of soap for the purpose of restoring and increasing the luster, and is finally washed and brightened. Zinc sulphate may be employed in place of the magnesium salt, but does not give as good results.

There are a number of other methods for the bleaching of tussah silk, but from the author's experience the one mentioned above seems to give the best result, and the others are apparently without any practical value. A process of combining the sulphuring process with the sodium peroxide method is as follows:

The silk is first sulphur bleached with sodium bisulphite and then steeped in a bath made of 7 gallons of water, 1½ gallons of hydrogen peroxide, and 1½ pounds of sodium silicate for several hours. As these two processes are diametrically opposed to each other in principle, the one being a reduction while the other is an oxidation, it might be expected that they would mutually neutralize each other more or less, and experience proves this to be the case. Sulphuring and then bleaching with sodium peroxide does not give any better results than using the sodium peroxide solution alone.

Another method which has been used to some extent is as follows: (1) The tussah silk is worked in a warm dilute (1 to 8) bath of hydrochloric acid for 1 hour; (2) wash and boil off with a 5% solution of sodium carbonate or a 2% solution of caustic soda and wash again; (3) steep in a weak solution of ammonium hypochlorite for twenty-four hours. This solution is prepared by mixing together solutions of bleaching powder and ammonium carbonate, allowing to settle and using the clear liquor; (4) wash and pass into a dilute bath of hydrochloric acid at 2° Tw. and wash again; (5) steep for twenty-four hours in a bath of hydrogen of one-half volume strength with the addition of ammonia or borax. The function of the first treatment with hydrochloric acid is to remove the lime present in the tussah silk.

The treatment with ammonium hypochlorite is considered as being superfluous, as no advantage is gained over the bleaching of tussah silk with hydrogen peroxide alone. From experiments made by the writer it appears that the best conditions for bleaching tussah silk with hydrogen peroxide is to use 1 part of 12-volume hydrogen peroxide alone, with 10 parts of water and then adding to the bath one-half ounce of silicate of soda for each 22 ounces of the bath, and this solution may be used for steeping the silk for ten hours cold, and heated to 190° F. for two hours.

Ammonia, magnesia and borax do not give as good results as sodium silicate as additions to the bath. The use of hydrogen peroxide and hydrosulphite compounds give a fair bleach, and the bleaching is effected in two stages. Hydrogen peroxide solution of 6 to 10 volumes strength is made faintly alkaline with ammonia, then heated to 100° F. The silk is then completely immersed in this solution where it is allowed to remain for ten hours, and in practice it is customary to give the silk a preliminary treatment in a peroxide bath which has already been used once.

The bleached silk is washed in soft luke-warm water and is then scoured in a solution containing 1 part of oxalic acid to 1,000 parts of water for from three to four hours at a temperature of 160° F., and after passing through this treatment the silk is of a pale yellow color. To give the final bleach, a solution is made up of 1 part of hydrosulphite compound to 100 parts of water at 120° F. The well washed silk is immersed in this solution for ten hours, then rinsed in soft water and dried at a very low temperature to give the right hand and feel, and it should then have a fine lustrous white appearance. The hydrosulphite may be used separately, being freshened up each time with the necessary amount of the hydrosulphite compound, and the strength of the bath may be determined by titration with Indigo carmine solution.

From a study of the different processes of bleaching tussah silk, one more that is in use a great deal may be added:

For 100 pounds of tussah silk a bath is prepared containing 250 gallons of water, to which is added 26 pounds of sulphuric acid (168° Tw.) and 20 pounds of sodium peroxide, the excess of acid then being neutralized by the addition of a slight excess of sodium silicate. The previously boiled-off silk is entered into this bath, and in the course of half an hour the temperature is gradually raised to 140° F. The silk is turned occasionally during six to eight hours when the bleach should be complete. The silk is then removed and thoroughly mixed in tepid water and next passed into a warm dilute solution of sodium bisulphite, to which is added a small quantity of hydrochloric acid, and after an immersion of fifteen minutes in this bath the silk is removed and well washed to remove all traces of acid and finished according to requirements.

Aftertreatment of Bleached Silk

After silk yarn has been scoured and bleached, it may be used either for subsequent dyeing or employed directly as bleached material for the purpose of weaving or other processes of manufacture. In the latter case, after the silk has been bleached it is usually weighted with stannic chloride, but as this is a product employed as an adjunct in dyeing, it will not be considered at this point. There are various mechanical treatments, however, which are customarily given to the bleached silk in the skein form, and these include scrooping, shaking-out, stringing and lustering.

Scrooping.—This is for the purpose of giving the silk fiber a stiff or harsh quality so that when squeezed or rubbed, it emits a crackling or crunching sound. Contrary to the popular opinion, this property of scroop is not one that is natural to the silk fiber itself, but is an acquired property given to it by special treatment. For the scrooping of silk the material is usually steeped in a bath of tartaric acid containing 5 grams per liter until the fiber is thoroughly impregnated with the solution, then squeezed out and dried without rinsing. In order to produce a good scroop the silk must not be oiled, as this will prevent the development of the characteristic "crunch."

Shaking-out.—This process is used to open out the skeins of silk so as to straighten the threads and separate them from each other, and it also gives the silk a uniform appearance and lessens the tendency of the fiber to curl and wrinkle. This process is usually performed after drying and simply consists of hanging the skeins of silk on a wooden peg or support and by means of a smooth stick pulling and shaking out the skeins in a vigorous manner. Special machines are also built for this operation, saving hand labor and giving more uniform results.

Stringing.—This is a process used in conjunction with the shaking-out operation, and its purpose is to straighten out the threads and to operate the double silk fibers into individual filaments and also to add luster or gloss to the thread. The operation may be conducted by hand, in which case the dried skeins are hung on pegs and then by means of a smooth stick the skeins are pulled and twisted tightly first in one direction and then in another. The operation is now usually conducted by means of a special machine designed for this purpose, the skeins being hung on spindles and automatically twisted first in one direction and then in the other. In some cases the stringing is done simply by twisting the skein as tightly as possible and leaving them in this position for several hours, and then repeating the operation until the threads are straight and the yarn separated with a fine luster. This method is used principally on sewing silks and is for the purpose of giving an increased luster to the fiber.

Lustering.—This operation is used in conjunction with the preceding, and is a final process given to all skein silks, whether bleached or dyed. It is for the purpose of giving a high degree of luster to the fiber and it also helps considerably in the subsequent winding of the silk from the skeins. In carrying out this process a silk lustering machine is used, the silk skeins being stretched between polished steel revolving rollers, and these are enclosed in an iron box. While the rollers are turning, steam at a moderate pressure is entered into the box so that the hot, dry steam acts on the stretched fiber. This process will give the silk a beautiful, brilliant mother-of-pearl luster.

Bleaching of Half-Silk Fabrics

Half-silk fabrics consist of a mixture of cotton and silk fibers, usually a cotton warp and a silk filling. Ribbons, dress goods and fancy fabrics are often of this mixture, and the bleaching of such goods presents certain difficulties because the ordinary methods of bleaching cotton goods cannot be applied. They would ruin the silk fiber. Furthermore, the usual methods of bleaching silk will not always give a suitable bleach for the cotton. Half-silk fabrics, for instance, cannot be successfully bleached by treatment with hypochlorites, as they have an injurious effect on the silk, while on the other hand sulphurous does not furnish a satisfactory bleach to the cotton, and is liable to tender this fiber by the formation of sulphuric acid.

The only satisfactory method of bleaching half-silk fabrics is by the use of peroxides. The goods should first be given a good boil out in a good neutral soap solution, taking care to use a soap free from caustic alkali, or otherwise the silk fiber will be injured and suffer a loss of luster. The bleaching solution is prepared from peroxide of hydrogen or of sodium and should be a rather concentrated one. If a weak peroxide bath is employed, the bleaching action on the fiber will be too slow, and as a result the cotton will not come up to a satisfactory white, while the silk is liable to turn a yellow or brown shade.

The vats employed for the bleaching should be lined with Monel metal and care must be taken to keep any other metal from getting into the bath. Even lead pipes for heating should be avoided, and the steam introduced by means of a rubber hose. The undesirability of the use of lead pipes is due to the fact that in the strong peroxide bath the liberated oxygen will combine with the lead to form a brown lead peroxide which will be absorbed by the silk and will give it a yellow shade. It is well to use a 3 to 4% peroxide bath, neutralized with sulphuric acid and heated to 140° F. Just before the introduction of the goods into a Rusden rope soaper or other type of machine, the bath should be made slightly alkaline by the addition of 2 quarts of sodium silicate. As soon as the material has come up to a good white in about six hours, it should be removed from the bath and washed several times, first in dilute oxalic acid and then with water.

Influence of Water in Processing Silk

The character of the water employed for the preparation of soap baths has much to do with the success of treating silk fibers, and if hard water is used, insoluble soaps will be formed which will stick to the silk fibers and is very difficult to remove satisfactorily. Such water should always be softened by treatment with alkalies, so as to remove all of the lime and magnesia compounds and then filtered. It is a well-known fact among the testing laboratories that more and more silk is being spoiled by impurities in water used in soaking the silks for the throwster, for boiling off, dyeing, bleaching, etc., than from any other process carried on in the silk industry.

As silk is such a high-priced material every care should be taken to preserve its valuable qualities to the utmost, and on this account only very soft water should be employed in processing this fiber. The usual water obtained from natural sources, as a rule, is not sufficiently soft to use with silk, and consequently a suitable softening process for the water should always be used. There are a great many water-softening systems in use in silk mills, and by the use of such systems a water of zero hardness can readily be obtained and the quality of the silk enhanced.

As to the bleaching vats used when boiling off small lots of silk where copper tanks are employed, care should be taken to avoid copper metallic stains from the verdigris that is likely to form in the copper surface by the combined action of the soap liquor and the air. By keeping the vats clean, however, there is little danger of stains arising on the silk, and it is well to wash out the vats after every boil off.

WHO DOES THE LAUNDRY?

The Bureau of Home Economics, Department of Agriculture, has concluded an interesting study, covering representative sections of the country, of the various agencies through which the laundry is done.

This survey discloses the fact that as the size of place of residence grows, the proportion of families who reported the laundry done by a member of the family decreases, while the percentage reporting laundering by a paid worker in the home and by a public laundry increases. Size of income also had considerable to do with the type of laundry service used. Generally speaking, the use of the public laundry increased with the increase in size of income in the case of all items except women's hosiery. Dresses, underwear and hosiery were, in most instances, laundered at home, while household articles were generally sent to a public laundry.

The percentage of independent, self-supporting women, as in the case of families laundering articles of clothing themselves, was greater than those using any other kind of service. Most silk and rayon garments were laundered in the home, while cotton dresses and underwear were usually done by a paid worker or by the public laundry.

Papers of the Division of Dye Chemistry

Of the American Chemical Society

SEVEN technical papers of unusual interest to dye chemists were presented following the business meeting of the Division of Dye Chemistry held last Tuesday, September 10, at Minneapolis. The meeting was called in conjunction with the fall meeting of the American Chemical Society. Abstracts of the papers follow:

The Effect of Isomerism on the Solubility of Salts of Aromatic Sulphonic Acids (M. L. Crossley).—Several different types of salts of aromatic disulphonic acids have been made and their solubilities compared. It is shown that there is marked difference due to the position of the sulphonic acid group with respect to other substitutes on the ring. The maximum variations are shown by mixed salts of the isomeric acids. The differences manifested run parallel to the differences in reactivity of the acids, and also harmonize with the facts found for the variations in the colors produced when these isomeric sulphonic acid derivatives are used as dye intermediates.

Studies in the Friedel-Crafts Reactions. Napthalene Series No. 1. Preparation of Naphthanthraquinone. (1, 2-*Benzanthraquinone.*) (1, 2-*Benzanthrene-7, 12-Dione.*) (P. H. Groggins and H. P. Newton.)—A study of the following factors was undertaken in order to determine the optimum conditions involved in the Friedel-Crafts synthesis for the preparation of a-naphthoyl benzoic acid: (1) Solvents for the reaction; (2) ratio of naphthalene to phthalic anhydride; (3) ratio of anhydrous aluminum chloride to phthalic anhydride; (4) hydrolysis of the reaction compound; (5) formation of ammonium salt of a-naphthoyl benzoic acid; (6) method of precipitating a-naphthoyl benzoic acid; (7) relation of agitation to yields and purity; (8) relation of reaction temperature to yields and purity. The crude product titrated 99 per cent pure, was above 97.5 per cent in yield and of a white crystalline structure.

A thorough study was made of the effect of time, temperature, acid ratio, acid concentration, methods of dilution, inhibitors of sulphonation, agitation, and equipment upon the ring closure of a-naphthoyl benzoic acid to naphthanthraquinone. Yields of naphthanthraquinone from both the pure and the crude a-naphthoyl benzoic acid were in excess of 90 per cent and practically identical in purity.

1-*Amino*-2, 4-*Dichloroanthraquinone* (Ivan Gubelmann and H. J. Weiland).—A method for preparing 1-amino-2, 4-dichloroanthraquinone from meta-dichloro benzene is discussed. The synthesis includes the following steps:

1. The condensation of meta-dichloro benzene with phthalic anhydride in the presence of aluminum chloride to give 2', 4'-dichloro benzoyl ortho-benzoic acid.

2. The nitration of 2', 4'-dichloro benzoyl ortho benzoic acid and the subsequent reduction of the nitro body to give 2', 4'-dichloro-5'-amino benzoyl ortho benzoic acid.

3. The condensation of 2', 4'-dichloro-5'-amino benzoyl ortho benzoic acid to the anthraquinone body.

Some New Azo Dyes of Exceptional Fastness (H. Jordan, A. O. Bradley and E. F. Hitch).—This paper discusses a new series of azo dyes and specifically describes some members of the series. The novel feature of these colors consists in the introduction of one or more amino-benzoyl groups or substituted amino-benzoyl groups in monoazo, disazo or trisazo compounds. As a general rule the presence of such groups in the molecule increases the affinity of the compound for the fiber and produces colors of improved fastness to washing and to light. Some of the direct colors described have fastness properties approximating some of the vat colors of similar shade.

The Fusion Curve of the System Alpha-Naphthylamine—Beta-Naphthylamine (Ivan Gubelmann and H. J. Weiland).—The fusion curve of alpha-naphthylamine—beta-naphthylamine in the vicinity of the concentration range, 90 per cent alpha-naphthylamne to 100 per cent alpha-naphthylamine is presented. The melting point of pure alpha-naphthylamine is reported in the literature in various places, but is variant and in most cases incorrect. Technical alpha-naphthylamine has an amino content apparently equivalent to close to 100 per cent. It, however, has been found to be a variant mixture of amines.

Preparation of Para-Phenyl-Ortho-Benzoyl-Benzoic Acid and Its Derivatives (P. H. Groggins).—A comprehensive study was made on the preparatioin of para-phenyl-ortho-benzoyl-benzoic acid. The Friedel-Crafts condensation of diphenyl with phthalic anhydride was carried out with and without the use of solvents. A process using molecular proportions of reacting materials and without the use of solvents was developed. Condensations of both ortho-chloro-diphenyl and para-chloro-diphenyl were carried out in a similar manner. The results were uniformly good. From the halogen derivatives it was found practicable to prepare the hydroxy and amino compounds. The amination of the keto acid does not proceed smoothly. Only a slight conversion is obtained without the use of catalysts, while copper and its salts tend to the formation of amino compounds.

Preparation of Beta-Phenyl-Anthraquinone and Its Derivatives (P. H. Groggins).—When unsubstituted para-phenyl-ortho-benzoyl-benzoic acid is treated with sulphonating dehydrating agents, such as sulphuric acid or sulphuryl chloride, only the sulphonic acids of beta-phenyl-anthraquinone are obtained. The method evolved for effecting ring closure depended on the use of inert solvents in the presence of dehydrating agents, such as aluminum chloride. When a para substituent is put in the keto acid, sulphuric acid may be used to effect the removal of water. If, however, the substituent is in the ortho position it is necessary to use an inert solvent, such as nitrobenzene, along with either sulphuric acid or sulphuryl chloride. From the 4-chloro and 2-chloro-beta-phenyl-anthraquinones it was found convenient to prepare the corresponding amino derivatives by treatment with ammonia under pressure. The use of a copper catalyst is essential. The addition of nitrobenzene accelerates the amination.

TEXTILE ENGINEERS WILL TALK ON SAFETY IN THE MILLS

Annually the safety movement in industry gains impetus from the Safety Congress held by the National Safety Council. This year, when the safety engineers gather in Chicago from September 30 to October 4, the textile manufacturing industry will take an active part in the program. Three sessions will be held by the Textile Section of the Council.

At a luncheon scheduled for September 30 the activities of the Textile Section will be outlined by its chairman, D. Frank Lord; various committees will report and a talk will be given on "Interpretation of Textile Accident Statistics." The following morning there will be an address on "Training the Textile Supervisor for Safety," by C. H. Eames, president, Lowell Textile Institute, Lowell, Mass., followed by a discussion, and a talk on "Comparison of the Several State and A. S. A. Codes on Textile Machine Guarding," by Harry Immel, director, Bureau of Inspection, Pennsylvania Department of Labor, Harrisburg, Pa., also followed by a discussion.

On Wednesday morning, October 2, the Textile Section will elect its officers and listen to two addresses. W. C. Wroe, district engineer manager, American Mutual Liability Insurance Co., Atlanta, will talk on "The Overseer's Responsibility in Accident Prevention," and there will also be an address on "Meeting Code Requirements by the Textile Machine Builder." Each talk will be followed by discussions.

SCHOLARSHIP AIDS ARGENTINE CHEMISTS

While visiting the United States Dr. Carlos Abeledo, chemist of the Bureau of Chemistry in the Argentine Republic, was impressed by the methods employed in our laboratories and became interested in the possibility of having young Argentine chemists receive a year or two of experience here. He proposed the plan to the Pan-American Union, and this organization has recently sent the following letter to the Synthetic Organic Chemical Manufacturers' Association, addressed to the secretary, Charles Mace:

My Dear Mr. Mace:

Last February Dr. Carlos Abeledo, chemist of the Bureau of Chemistry in the Argentine Republic, visited the United States and saw a number of industrial laboratories. He was greatly impressed by the methods of work and became interested in the possibility of having young Argentine chemists receive a year or two of experience here. His idea is to obtain a sort of working scholarship whereby one or two Argentines might have remunerative employment in some American laboratories, the scholarship being offered each year by a different concern so as not to burden any one of them. He thinks the Argentine Chemical Society could undertake the selection of suitable candidates.

I am therefore writing to inquire whether some mem-

bers of your association would be willing to receive properly accredited Argentine chemists for a year or two of training. While I appreciate the fact that they would not be of much real service for the first few months, there is a definite publicity and good-will value in their returning to South America with a familiarity with your products. Looked at from a broad point of view, there is a distinct business advantage in having in foreign countries persons who naturally help to increase the market for American chemical products.

Hoping that you will give favorable consideration to this plan of accepting a student-worker from time to time, I am

Sincerely yours,

L. S. ROWE,
Director-General, Pan-American Union.

CASTLE PIECE DYE OPENS WEIGHTING DIVISION

The Castle Piece Dyeing & Finishing Company, of New York, has recently established a weighting division which is now in operation on crepe-de-Chine, Georgettes and satin crepes.

The new division has been equipped with the very latest model dyeing machinery, and more than doubles the capacity of the plant. It is installed in an addition 80 by 100 feet, erected especially to provide space for two weighting units.

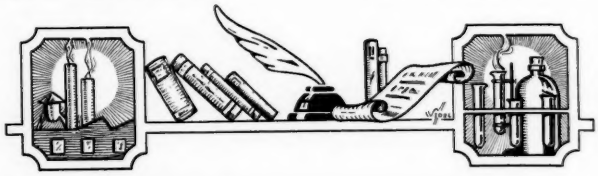
Until taking this step the firm has always engaged exclusively in pure dye work, and it was but a few months ago that the executives decided to enter the weighting field. Peter Ross, one of its founders and treasurer of the company, is its representative in the trade.

The Castle company has its own water supply from a well sunk 500 feet a year ago which gives a 6-inch flow continuously, while a reserve tank holds 26,000 gallons.

COTTON COURSE AT COLUMBIA, NEW YORK

The course in cotton manufacture and finishing of cotton goods will open again this year at Columbia University, New York, on September 27, with regular winter and spring sessions. This course is catalogued as "Textiles eZ1 and eZ2," and is given every Friday evening from 7:30 to 9:30 o'clock. The instructor is Herbert Mauersberger, B.T.E., a graduate of Lowell Textile Institute and member of the firm of Cox, Fuller & Mauersberger.

The lectures in this course have been arranged especially for commission-house men, converters, jobbers, merchants, buyers, salesmen or those handling cotton fabrics and products, and who, for business reasons, would like to know more about these materials. The lectures will be sufficiently scientific for accuracy, it is stated, but not strictly technical. The lay person can follow them readily and they should be of interest to decorators, modistes and stylists.



RECENT LITERATURE

Our Chemical Industry Grows Up

The American Chemical Industry—Production and Foreign Trade in First Quarter of the Twentieth Century. United States Department of Commerce. Trade Promotion Series No. 78. 114 pages. 20 cents.

The enormous growth of one of our most important basic industries is recorded in this story of the rise and development of chemical industry in the United States since 1900. It is a story of industrial history that possesses interest and importance because it deals with an enterprise that is vastly important, an enterprise upon which depends the progress of a score of our major industries. For if our chemical manufacturing business had not developed; if our production of essential chemical products had by some misfortune not kept pace with production in Germany or in England in the past quarter century, we should be in a sorry way indeed to-day.

The relation between a domestic supply of chemicals and the prosperity of our industrial world is a story which has not yet been told, but doubtless it will be told some day. This book does not emphasize such a relation, but it does give statistics and facts about the manufacture and marketing of American chemicals which convey a picture of the enormous growth of the industry, a picture business men can understand.

The development of the chemical industry from a relatively insignificant position to one of first importance during the past quarter century has been accompanied by many radical changes, both in markets and in sources of raw materials. Europe, it is pointed out, has always been both our largest market for chemical products and Europe still holds first position, its share in our total foreign chemical trade has fallen markedly. At the beginning of the century it took nearly 70% of our foreign shipment and supplied 71% of our imports. In 1927 these ratios had dropped respectively to 41% and 50%. This decline in the face of a threefold increase in exports to and imports from that area is explained by the fact that the United States expanded its trade with other geographic divisions to a much greater degree than it did with Europe. The tremendous expansion in our exports to the Far East and in imports from the Far East and from South America are the chief causes of the change noted in the European proportional share of our trade. As the needs for crude materials for processing and manufacture rose, American consumers purchased in greater amounts direct from primary sources and at the same time reduced their purchases of finished commodities formerly obtained from Europe.

Germany Our Best Customer

The total value of American chemical exports in 1927 was $184,000,000, of which $75,000,000 went to European markets. The United Kingdom ranked as our foremost individual market, taking 15% of our total exports as compared with 25% in 1899. Germany, which ranked after the United Kingdom, took 10% of our foreign chemical shipments in 1927. During the twenty-five years reviewed Germany has trebled its chemical purchases from the United States. It is now the largest single market for American coal-tar products.

Referring to the enormous increase in American production of chemical products, it is pointed out that this is by no means due to the World War alone, as is so often claimed, but to a variety of causes. Chief of these is the increased purchasing power of the American people, creating a demand for highly processed chemicals for private consumption, such as medicinal, pharmaceutical and toilet preparations, as well as for the products of chemical-using industries, such as textiles, with their need for dyes, bleaches and textile chemicals, and automobiles, with their demand for paints.

Copies may be obtained from the Government Printing Office.

Statistics on Imports

Free and Dutiable Imports of the United States in the Calendar Year 1927. Department of Commerce. 17 pages. 10 cents.

To settle some of the tariff arguments which now echo on the walls of Congressional committee chambers and around the conference tables of industrial leaders, it would not be such a bad idea to quote some actual figures on the products we import during the course of one year. All this information is arranged in tables in this small booklet, products being classified according to economic character and the commodity grouping of the articles imported.

Recent Economic Changes in the United States—Elimination of Waste Series. U. S. Department of Commerce. 32 pages. 5 cents.

This gives the results of one of the surveys undertaken as an outgrowth of the President's conference on unemployment of 1921, a survey made in order to enlarge the general understanding of our economic system and to stimulate the continuing reduction of unemployment.

TWO HANDSOME DYESTUFF BOOKS

Volume on Indigosols and Shade Card on Rayon Dyes Issued by General Dyestuff Corporation

"The Indigosols Applied in Textile Printing" is the title of a book issued recently by the General Dyestuff Corporation of New York.

The word "Indigosols," it is explained, designates a series of stable preparations, readily soluble in water, of the leuco compounds of vat dyes which are of particular interest for printing and padding. Indigosol O, the first of the series placed on the market several years ago, has been followed by a number of other brands to make up an almost complete line of shades.

This handsome book explains the chief uses of the Indigosols in textile printing. The first chapter deals entirely with calico printing, and takes up in turn the process for producing print-on styles with the Indigosols, for padding, for resist printing and for Indigosol resists under Aniline Black. The second chapter is concerned with the printing of rayon, both the viscose and the acetate types. The last two chapters describe the processes of silk printing and wool printing, respectively.

The volume is unquestionably one of the most attractive that we have had the pleasure of seeing, and takes a unique place among the publications so far issued by dyestuff manufacturers. Almost every other page contains a number of dyed pattern swatches which illustrate every process described in the text. The book contains eighty pages and is excellently bound in blue fabrikoid.

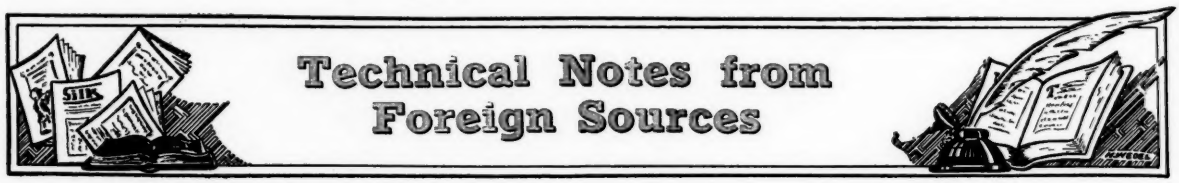
Card on Rayon Dyes

The second publication issued recently by the General Dyestuff Corporation is a shade card entitled "Dyeings on Rayon Yarn—Agfa Viscose." The card is in the form of a heavy folder and contains 300 dyed swatches of rayon yarns, colored in shades, tints and hues of every color in the Fastusol series of direct dyestuffs. A few diazo dyestuffs are also shown, as these are used when fastness to washing on rayon is desired. A page of dyeing recipes are given, and the strengths of each color are shown in the swatch pages.

FRANKLIN PROCESS SERVICE SHOWN IN NEW BROCHURES

For the purpose of promoting the sale of fabrics containing Franklin Process colored yarns, the Franklin Process Company has issued an attractive booklet entitled "Why Franklin Process Colors and Where." This was prepared especially for wholesalers, retailers and cutters, and its text explains this company's method of guaranteeing the fastness of its dyed yarns, the method of dyeing and information about the service offered by the Franklin Process Company. The book contains colored reproductions of Franklin Process advertisements and a directory of representative fabrics and garments containing Franklin-dyed yarns.

A second booklet issued by this firm is entitled "What Franklin Process Can Do for You," and deals with the secret of modern merchandising success and how Franklin Process applies the principle to its merchandising problems. This book also contains attractive reproductions of advertisements in color.



Secondary Dis-azo Dyestuffs

German Patent No. 431,235; *I. G. Farbenindustrie A.-G.*—Mono-acidylated or mono-ureated diamines of the benzene or naphthalene series, e. g., p-amino-acetanilide, are diazotized and coupled to amino-naphthol ethers, the components in either case being sulphonated or unsulphonated, or in the case of the first component carboxylated, and the mono-azo-dyestuff formed diazotized and coupled with 1-8-amino-naphthol-sulphonic acids or 1-8-dihydroxynaphthalene-sulphonic acids, or derivatives thereof. The products level well, possess good fastness to light and washing, dyeing in clear bluish-green to green shades.

Yellow Azo Dyestuffs

German Patent No. 431,235; *I. G. Farbenindustrie A.-G.*—Naphthylamine sulphonic acids are diazotized and coupled to diphenylamine, and the resulting yellow dyestuffs gently nitrated as usual for diphenylamine dyestuffs. The products show good affinity for wool, silk, and leathers; for silk in particular better than the Indian Yellows and Azoflavines.

Pigments of the Naphthol AS Series

German Patent No. 433,211; *I. G. Farbenindustrie A.-G.*—Tetrazotized diamino-disazo-dyestuffs (gotten by coupling tetrazotized aromatic diamines, unsulphonated, to amino compounds of such a nature that the dis-azo-dyestuff resulting can be further tetrazotized) are coupled with the arylides of 2-hydroxy-3-naphthoic acid, either by themselves or upon a substratum. The products are blacks, deep-black or greenish or bluish.

The original patent covered products produced by coupling tetrazotized aromatic diamines, unsulphonated, to the arylides.

Pyrazolone Dyestuffs

German Patent No. 434,932; *I. G. Farbenindustrie A.-G.*—Sulphonated ortho-hydroxy-amines are diazotized and coupled to unsulphonated 1-naphthyl-3-methyl-5-pyrazolones. The products are orange to bluish-red dyestuffs, of great value for wool dyeing.

Naturally, the tones are made deeper than those of the phenyl homologues by the use of naphthyl-methyl-pyrazolones.

Some New Procedures in the Rayon Industry

Dr. Walter Obst; Die Kunst-Seide 10, 503 (1928).—In no other industry are new methods starting up before us as to-day in the rayon industry. Their number is due to the manifold nature of the methods of producing the fiber, the various methods of use of the fibers which is possible, and the rapid chemical as well as technical advances in this field. It is therefore possible only to offer a summary of these procedures, which might offer suggestions for future work.

The desired production of non-lustrous rayon of great softness has found fulfillment in a patent of Erich Heymann, and depends upon the principle of impregnation, of all kinds of rayon, of any source whatever. To the spinning solution are added non-volatile or difficultly volatile substances, as oils, fats, waxes, fatty acids, aniline, tetrahydronaphthalene, nitrobenzene, or emulsions, suspensions, or colloidal solutions, such as soaps, etc. It is a case, therefore, of an uncommonly comprehensive patent, which covers the use of nearly all sorts of additive substances of an anywhere nearly suitable and important nature, with the exception of certain weighting substances that have already been proposed in another place. The present patent is one of those which would have to be acquired by the whole industry for its own interests, in order to make it available to all firms working along these lines. In the patent procedure the volatile materials are removed from the fiber after formation by solvents or by simple evaporation in vacuo. The procedure may be illustrated by a few examples: Thus, to 1,000 g. of viscose 5 g. of linseed oil are added, and the synthetic fiber generated in the usual way. The fibers contain the linseed oil in the form of the most finely divided droplets, which give the fiber a handsome dull luster. Or, 150 g. of soda-cell substance are transformed in the usual way through cellulose xanthogenate to viscose, with 18 to 26 g. of carbon disulphide, with the addition of 3 g. of aniline or olive oil, and the fiber, spun as usual from this solution, afterward treated warm with benzene, whereby a fifth of the amount of aniline or olive oil added is extracted. After evaporation of the benzene, the silk is dully-lustrous and pliable. The procedure, which is a decidedly significant one, can possess interest only for rayon manufacturers, but, however comprehensive the patent appears in reference to the addition materials proposed, it refers to their addition only during the process of manufacture, and the patent covers just this; the possibility of a likewise as effective impregnation of the finished fiber is not excluded from consideration, but this possibility is apparently not comprehended and covered by the patent.

A French patent also covers the above German procedure; mention must be made, in this connection, that there exists a Japanese patent, which covers the addition of colloidal solutions of animal or vegetable albuminous substances and fatty oils to the precipitating bath, in some

cases in the presence of small amounts of alkalies, and therefore with the formation of soaps; likewise a French patent has already been granted on this point, so that the danger of conflict between these patents may arise—but these cases are not rare in the patent field of to-day.

Patents relating to addition materials in the precipitating bath are certainly numerous, but in this case, too, points of mutual contact between patents are not lacking. Thus, the I. G., according to a German patent, for whose procedure a British patent has also been granted, adds to the precipating bath for viscose rayons a trace (not over 0.1%) of a zinc salt, for example, zinc sulphate; while the Alsa Soc. Anon. in Basle likewise holds British patents, in which, to a precipitating bath of sulphuric acid, 6% or more of zinc sulphate is added. These may be cited as examples. In a further British patent the I. G. employs, in rayons from cupro-ammonium solutions, an aqueous precipitating bath to which carbon dioxide or a bicarbonate has been added. The N. V. Bouwonderneming Ketabang of Java, according to a British patent, leads the viscose fiber through a bath of caustic of such a nature that the precipitation is complete when the fiber leaves the bath and is wound upon spools.

Bassett of Kentucky, in an American patent, precipitates a cupro-ammonium-cellulose solution with a bath of caustic alkali of 40° B., washes the precipitated material in a bath of caustic of 15° to 20° B., and finally with a caustic bath very much weaker. The Brown Company, of Berlin, N. H., employs an American patent of G. A. Richter, which consists in heating an aqueous cellulose derivative solution, without precipitation taking place to any particular extent, for the purpose of diminishing the viscosity immediately before spinning; the solution is spun into a filament, and this led into the precipitating bath. The two following procedures are likewise similar; the Niederlaendische Kunstseidenfabrik employs a patent for producing cellulose acetate rayon of low luster, by introducing steam into the spinnerets, while O. Sindl, of Breslau-Carlowitz, holds a patent for moistening with water, through a fine nozzle, fibers of great fineness as they are generated in centrifugal spinners; the moistening taking place as the fibers pass over the draw rolls.

For desulphurizing of viscose rayon, the I. G. possesses a German and a French patent. The process is carried out by means of a solution of a more or less hydrolytically dissociated alkali salt or a caustic alkali, especially alkaline waste liquors, such as mercerizing liquors, which are diluted down to 1 to 2% caustic content; or, dry or moist, undesulphurized viscose silk is treated, for example, with a 1% soap solution for one-half hour at 95°. The soap can be replaced by Turkey Red oil, Marseilles soap, or a 2 to 4% soda solution.

W. Vieweg, Pirna a. Elbe, has been granted a patent for the production of especially firm fibers, suitable for weaving, from viscose, depending on the single fibers of a fineness of 1 to 3 deniers being passed, on generation, through capillary openings of that size, into a strongly-acting coagulating bath; the bundle of fibers, hardening as soon as formed, is led through the bath on a long, horizontal spinner, skeined up, and worked up as desired. S. Toda, a Japanese worker, has founded a British patent for viscose rayon upon a procedure which loosely twists a yarn, produced by coagulation of a viscose solution (twisted not more than fifty turns per meter), then weaves, without previous desulphurizing or bleaching. The I. G., according to a procedure patented in France, as well as Germany, precipitates viscose in a bath whose concentration at 46° amounts to 36% of Glauber salt and 17% of sulphuric acid. Fr. Kuettner u. Willy Linke of Pirna, in their patented procedure for producing rayon according to the viscose procedure, use as precipating bath an aqueous solution of sodium sulphite, to which magnesium sulphate is added to the point of saturation. According to a procedure of Inoxi, in France, crepe fibers of rayon are formed by treating with glue before spinning, in order to discourage their stretching.

Regarding the influence of the different substances added to the precipating bath, it is established, among other facts, that magnesium sulphate raises the tensile strength of the fibers when added in sufficient amount. On the other hand, the influence of zinc sulphate upon the properties of the fiber formed is varied in nature; with reasonably ripened viscose a certain amount of zinc sulphate has a decided influence upon the increase in stretching power and tensile strength. It may be mentioned, in conclusion, that Japanese investigations have shown that the stability of viscose is highest at a concentration of 6 to 8% free alkali; a viscose which contains more or less than this is less strongly dispersed, and coagulates in a shorter time.

Vat Dyestuffs of the Anthracene Series

German Patent No. 436,537; *I. G. Farbenindustrie A.-G.*—The products are of the general type of the so-called "Schiff's bases," and are obtained by condensation of amino- or poly-amino-anthraquinones, their substitution products, or arylidene-derivatives of all of them, with aldehydes of the anthraquinone series. The anthraquinone radicals involved, apart from the amino and aldehyde groups, may be the same or different. Instead of the amino-anthraquinones themselves, their arylene derivatives are successfully employed when the free amino-anthraquinone possesses such poor solubility, etc., that it does not react easily. A benzylidene derivative of the amino-compound—e. g., in such a case—readily splits off benzaldehyde, whose place is taken by the aldehydro-anthraquinone radical. The products dye pink, Bordeaux, yellow and brown, of excellent fastness.

TWO NEW INDANTHRENS ANNOUNCED

The General Aniline Works, Inc., has added to its range of Indanthrens two recent shades, Indanthren Blue BCSA and Indanthren Brown GGA. Circulars describing the properties of both colors have been issued by the General Dyestuff Corporation.

The Indanthren Blue is said to correspond in shade and fastness properties with the imported BCSO. Its fastness to chlorine and its solubility have been improved, it is further stated, and it is claimed to be an excellent product for machine dyeing. For dyeing purposes the powder brand is generally recommended.

The new Indanthren Brown GGA is said to correspond in every way with the GG type and is slightly yellower and brighter than Brown GA. It is recommended in the announcement for the dyeing of cotton goods which have to meet high fastness requirements and which must stand up under severe conditions of weather, wear and washing. It is said to be particularly suited for cotton drill and shirtings of the government khaki shade, and for ginghams and similar cotton materials.

ON THE MAP

Waynesboro, Va., has been put on the air-map by the Du Pont Company, which has painted the name of the town on the roof of the spinning building of its new acetate rayon plant.

This identification is in accordance with the suggestion of the Guggenheim Foundation, which is asking towns and cities throughout the country to identify themselves to travelers in the air.

The Waynesboro identification is in block letters 20 feet high and extending 205 feet. There is also a directional arrow pointing to the local airport, which is a much used field on a direct line between Langley Field at Hampton, Va., and McCook Field at Dayton, Ohio.

The colors adopted in this marking are of standard chrome yellow. In addition, the Du Pont Company is identifying itself by painting a Du Pont oval in red on a roof near by. This oval will occupy a space 40 by 100 feet, and will serve to more fully identify Waynesboro.

John Shoffner, John S. Thomas and Howard Fogelman, of Burlington, N. C., have organized a new company and have purchased the dyeing and finishing equipment of the Love Knitting Mills at Burlington. The new organization will do custom dyeing and finishing, specializing in handling the finishing of hosiery in the Burlington district.

The Ohio Dye & Finishing Works, Inc., Louisville, Ky., has taken bids on general contract for an addition to mill, including improvements in present plant. D. X. Murphy & Bro., Louisville Trust Building, are architects; Warren & Ronald, Heyburn Building, are consulting engineers.

OPENS CANADIAN BRANCH

The American Aniline & Extract Company, of Philadelphia, has opened a branch office in Canada, which will be known as the Canadian Aniline & Extract Company, and which will be located at 35 Cannon Street East, Hamilton, Ontario.

The company announces that a complete line of its products will be carried at the new branch, and some of the most important will be manufactured at the Canadian plant.

The Plaza Silk Mills, Inc., Paterson, N. J., recently formed with a capital of $40,000, to operate a broad silk mill, will be represented by Philip Weiss, 437 Hamilton Avenue, one of the incorporators. Henry Grubel and Aaron H. Schwartz, also Paterson men, are the other incorporators.

The Dominion Silk Printing Company, Ltd., Drummondville, Quebec, Canada, a subsidiary of the National Silk Dyeing Company, Ltd., Paterson, N. J., is building a one-story, 300 x 80 ft. brick mill in which the printing of piece goods will begin on November 15. L. F. Auger is president and W. S. Gall is treasurer and superintendent.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i. e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

SOUTHERN SALESMAN

Old-established manufacturer of dyestuffs and chemical specialties has an opening for a salesman for the Southern territory. Salary and commission. Good opportunity for the right man. State full particulars. Address: Classified Box 545, American Dyestuff Reporter.

HOSIERY DYER

Young American dyer of full-fashioned hosiery wishes position with live, progressive mill. Age 33; married. References furnished on demand. In or around New York preferred. Address: Classified Box 544, American Dyestuff Reporter.

THREAD DYER WANTED

Dyer, thoroughly experienced in direct, sulphur and indanthrene colors, cotton and rayon; knowledge of thread finishing necessary. New Southern plant. References. Mutual Thread Company, 17 West Seventeenth Street, New York City.

INDANTHRENE DYER

Indanthrene dyer experienced in rayon, silk, cotton and all types of machines. Excellent references. Address: Classified Box 546, American Dyestuff Reporter.